November 8, 2010

**Submitted Online (www.regulations.gov)**
Water Docket
Environmental Protection Agency
Mailcode: 28221T
1200 Pennsylvania Ave., NW
Washington, DC 20460

**Re: EPA Water Docket ID No. EPA-R03-OW-2010-0736, Draft Total Maximum Daily Load ("TMDL") for the Chesapeake Bay**

Dear Ms. Jackson:

The Hampton Roads Planning District Commission (HRPDC) appreciates the opportunity to submit these joint comments on behalf of the cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg, and the counties of Isle of Wight, Gloucester, James City, Surry, and York on the Environmental Protection Agency's September 2010 draft Chesapeake Bay Total Maximum Daily Load (TMDL).

The cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach own Municipal Separate Storm Sewer Systems (MS4s) that operate under individual Phase I MS4 NPDES permits issued by the Virginia Department of Conservation and Recreation (DCR), while the cities of Poquoson, Suffolk and Williamsburg, and the counties of Isle of Wight, James City, and York own MS4s that operate under a general Phase II MS4 permit issued by DCR. At present, Gloucester and Surry are not designated as MS4s, but could be so designated in the future due to population growth or modification of the criteria used to designate MS4s.

At the Commission meeting on October 20, 2010, the HRPDC acted to endorse the following position and attached comments.

- The cost of achieving the urban runoff sector allocations per EPA's backstop allocations would place an unreasonable financial burden on the residents of Hampton Roads. The estimated $1.05 billion in annual costs equates to a total average annual storm water fee of $1,670 per household equates to 2.3 percent to 3.0 percent of median household income (MHI).

- The EPA has not provided reasonable assurance that the urban runoff sector allocations can be achieved by 2025.

- The EPA does not have the legal authority to establish a deadline in the TMDL.
- The EPA does not have the legal authority to establish a deadline in the TMDL.
- The EPA has failed to provide the localities with a reasonable opportunity to review, evaluate, and comment on the basis for the proposed allocations.
- The Phase 5.3 model and model inputs are not sufficiently developed to produce reliable predictions.
- The modeling predictions do not justify use of the chlorophyll-a criteria as the basis for the James River basin allocations.

Attached is a detailed discussion of technical concerns and recommended revisions to the proposed TMDL. We look forward to continue working with the EPA to address the above-noted concerns and to continue improving the Chesapeake Bay water quality programs.

Sincerely,

Stan D. Clark
Chairman

Attachments

Copies: Doug Domenech., Secretary of Natural Resources
Hampton Roads General Assembly Delegation
Hampton Roads Planning District Commission

# Comments on the Draft Chesapeake Bay TMDL by the Hampton Roads Planning District Commission on behalf of the Hampton Roads Localities

## Docket Number EPA-R03-OW-2010-0736

## November 5, 2010

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## I. INTRODUCTION

The Hampton Roads Planning District Commission (HRPDC) appreciates the opportunity to submit these joint comments on behalf of the cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg, and the counties of Isle of Wight, Gloucester, James City, Surry, and York ("Hampton Roads Localities" or "Localities") on the U.S. Environmental Protection Agency's (EPA's) September 24, 2010 draft Chesapeake Bay Total Maximum Load (TMDL). The TMDL proposes total nitrogen (TN), total phosphorus (TP), and sediment allocations for the Chesapeake Bay's 64,000 square mile watershed, including "backstop" allocations for the James River and York River basins. EPA used a series of models, including EPA's new Phase 5.3 Watershed Model ("Phase 5.3 Model" or "Model"), and inputs to the models to derive the proposed allocations, which EPA characterizes as a "pollution diet" needed to restore the Chesapeake Bay and protect the James River. See Draft September 24, 2010 TMDL Report (TMDL Report) at pages i-iv.

The cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach own Municipal Separate Storm Sewer Systems (MS4s) that operate under individual Phase I MS4 NPDES permits issued by the Virginia Department of Conservation and Recreation (DCR), while the cities of Poquoson, Suffolk and Williamsburg, and the counties of Isle of Wight, James City, and York own MS4s that operate under a general Phase II MS4 permit issued by DCR. At present, Gloucester and Surry are not designated as MS4s, but could be so designated in the future due to population growth or modification of the criteria used to designate MS4s. All or parts of the MS4s are identified in the James River Tributary Strategy as located within the James River watershed. Parts of the Hampton, James City County, York County, and Williamsburg MS4s are identified in the York River Tributary Strategy as located within the York River watershed as is part of Gloucester County. **Exhibit A** is a descriptive summary of the Localities' MS4s and their storm water control programs.

At the outset, the Hampton Roads Localities wish to make clear that they are supportive of the TMDL's goals as reflected in their ongoing commitment of significant resources to implementation of their MS4 programs. Further, the Localities are supportive of and are prepared to commit more resources to their MS4 programs if needed to help restore the Chesapeake Bay and protect the James and York rivers, but the commitment of more resources must be supported by sound science. Unfortunately, however, as explained below, the TMDL lacks a sound scientific basis. Consequently, the Localities have very little confidence in the accuracy of the James and York river basin-wide backstop allocations in general and the urban runoff sector backstop allocations in particular. Further, even if one assumes for the sake of argument that these allocations accurately reflect the load reductions needed to restore the Bay and protect the James and York rivers, the magnitude of the tasks and estimated costs of achieving the load reductions are so great that it is not reasonable to expect that the reductions can be attained by EPA's 2025 deadline.

## II. EPA HAS NOT PROVIDED REASONABLE ASSURANCE THAT THE URBAN RUNOFF SECTOR ALLOCATIONS CAN BE ACHIEVED BY 2025

Virginia's September 2010 draft Phase I Watershed Implementation Plan (WIP) proposed allocations for the urban runoff sectors in the James and York river basins that would have required the Localities to reduce TP loads from their MS4s in the James River and York River basins by an average of 77 and 79 percent, respectively, from current loads.[1] The TMDL rejects the basin sector allocations proposed in the WIP, and in their place proposes backstop allocations that reduce the overall James and York basin allocations proposed in the WIP and transfers portions of the point source allocations to the agriculture, onsite septic system, and urban runoff sectors.[2] The backstop allocations offer some relief for the urban runoff sector (54 and 59 percent TP reductions in the James River and York River basins, respectively), but not nearly enough to provide reasonable assurance that the allocations can be attained by 2025. In fact, the following analysis of the controls that would have to be implemented to attain the backstop allocations for the James and York basin urban runoff sectors show that they are not achievable by that date.

The proposed backstop allocations reflect EPA's determination that Virginia's proposed allocations for the agriculture and onsite septic systems were too small in light of the absence of direct federal and state regulatory authority over these sectors. Although the urban runoff sectors gained additional allocations with the backstop, the gains are small and appear to reflect EPA's mistaken assumption that steep load reductions can be achieved by the urban runoff sector because this sector, unlike the agriculture and onsite septic system sectors, is subject to direct federal and state regulatory authority under the National Pollutant Discharge Elimination System (NPDES). However, this assumption fails to recognize the significant economic, technical and legal obstacles associated with controlling nutrient and sediment loads in

[1] The WIP allocations for TN and sediment would have required significant urban runoff source sector load reductions as well, but load reductions that would have been required by the TP allocations were the greatest of the three allocations.
[2] The backstop allocations are based on EPA's finding that the WIP failed to (1) contain sufficient commitments to provide reasonable assurance that Virginia would achieve the allocations for the agriculture and onsite septic system source sectors, and (2), in the James River, provide for compliance with the chlorophyll-a criteria.

urban runoff within an MS4 - particularly MS4s in coastal regions such as Hampton Roads - as well as the Localities' limited ability to require retrofits on private property.

**Exhibit B** shows that the average 54 (James) and 59 (York) percent load reduction needed to achieve the backstop allocation for phosphorus would require treatment of approximately 68 and 74 percent of the urban land area in the James River and York River basins, respectively.[3] The estimated total costs of treatment are approximately $9.8 billion (or approximately $1.05 billion per year[4]) after factoring in the added cost of designing storm water controls that would function effectively on the flat, low-lying terrain and in the soils and high water table that dominate the topography and hydrology in the Hampton Roads area.[5] However, as explained below, these estimated costs do not include the added cost of acquiring new easements and construction in existing utility easements.

The magnitude of the financial burden that would be imposed on the residents of the Localities cannot be overstated. As shown in **Exhibit C**, the estimated $1.05 billion in annual costs equates to a total average annual storm water fee of $1,670 per household, or $720 per person. These fees, in turn, equate to 2.3 percent of median household income (MHI), and 3.0 percent of MHI when the fees imposed on non-residential land owners are passed onto the consumer. Expressed another way, the estimated annual cost of attaining the allocations (without adding the cost of easement acquisition) represents 118 percent of the Localities' 2009 total annual expenditures for public safety (police and fire) and 37 percent of their total annual expenditures for schools. Further, as high as the estimated treatment costs are, they do not tell the whole story.

Treatment of well over half of the urban land area in the Localities would require extensive retrofits of existing development, most of which would have to be implemented independent of re-development in order to have any hope of meeting EPA's 2025 deadline. This is because re-development rates in the Hampton Roads region do not even begin to approach the rates that would be needed to achieve the backstop allocations entirely through re-development between now and 2025. The Phase I and Phase II Localities own an average of thirteen and three percent, respectively, of the urban land that would have to be treated to achieve the backstop allocations. The remaining urban land is privately owned, and the Localities cannot compel private landowners to install

[3] Although Exhibit B shows that the percent of urban land area that would have to be treated to achieve the load reductions needed to attain the total suspended solids (TSS) allocations are greater than the area that would have to be treated to attain the TP allocations, we have used TP as the benchmark for the cost estimates because it represents a mid-point in the percent reductions for TN, TP, and TSS. Further, the controls that will remove TP also serve to remove TSS. It is possible that the costs to achieve the TSS allocations could be higher than the cost to achieve the TP allocations in the York River basin.
[4] In addition to the cost of designing and installing the controls, the estimated annual cost includes operation and maintenance costs and 30-year bond financing at a 5.5 interest rate.
[5] The Localities evaluated three control scenarios to arrive at this cost estimate: (1) Scenario 1a - all best management practices (which includes voluntary urban nutrient management plans); (2) Scenario 1b - substituting storage for urban nutrient management plans; and (3) Scenario 1c – more reliance on storage than best management practices. See **Exhibit C.** Scenario 1c was selected as the control scenario reflecting the level of effort that would be required to achieve the allocations given the topography, hydrology, and soils in the coastal region and the Localities' experience to date with urban nutrient management plans.

retrofits in the absence of re-development requiring local land use approvals. Consequently, assuming for the sake of argument that they could meet the 2025 deadline, the Localities would have to acquire extensive easements through negotiation and condemnation for the installation and maintenance of controls. Easement acquisition, in turn, would add billions of dollars and years to the implementation schedule. Further, much of the Locality-owned urban land is utilized for utility infrastructure such as water, sewer, telephone, and electric lines. Even if one assumes that it would be feasible to use this land for storm water controls, the cost of moving or constructing around the utility infrastructure would add hundreds of millions of dollars to the $9.8 billion estimate and add years to the implementation schedule.

The foregoing analysis shows that controlling nutrient and sediment loads from urban runoff poses many of the same challenges and obstacles as controlling loads from agriculture and onsite septic systems. All three of these sectors will require extensive land-based controls on private property to achieve their respective allocations. EPA, Virginia, and the Localities cannot simply force private land owners to install controls in the absence of direct regulatory authority over the land owner (in the case of EPA and the State) or re-development requiring local approvals (in the case of the Localities). EPA appears to recognize the limits of its own authority over non-point source agriculture and onsite septic systems, but apparently refuses to recognize the limits on the Localities' authority over existing development. The Localities can acquire easements through negotiation or condemnation and install the controls themselves, but easement acquisition under these circumstances is extraordinarily time consuming and expensive.

In summary, it is apparent that EPA has wrongly assumed that the urban runoff sector allocations can be achieved by 2025 by virtue of federal and state regulatory authority over MS4s. In so doing, EPA has failed to recognize that in the absence of re-development requiring local land use approvals, the Localities have no more regulatory authority to require retrofits of existing development than either EPA or the Commonwealth of Virginia. Therefore, even if one assumes that the Localities can afford to spend well over one billion dollars each year between now and 2025 (which they cannot), EPA has not and cannot provide reasonable assurance that the James River basin backstop urban runoff allocations can be attained by 2025.

Having increased the agriculture and onsite septic system sector allocations to provide reasonable assurance that these allocations can be attained, it is incumbent upon EPA to increase the urban runoff sector allocations as well to account for the limits on federal, state, and local regulatory authority over existing development as well as the immense cost and difficulty associated with installing urban runoff retrofits.[6] Increased

[6] "Reasonable assurance" is not required by or defined in federal law; however, since EPA has chosen to employ reasonable assurance as the driver for assigning allocations among the source sectors, it is required to apply reasonable assurance among the sectors in a reasoned and consistent manner. The Localities submit that EPA has acted arbitrarily by proposing allocations for the urban runoff sector that do not account for the same factors (i.e., limited regulatory authority and economic feasibility associated with land-based controls) that it used to propose allocations for the agriculture and onsite septic system sectors. In fact, the much higher cost and greater difficulty of controlling nutrient and sediment loads from the urban runoff sector compared to the agriculture sector strongly suggests that on a pound-for-pound basis,

allocations for the urban runoff sector would contribute toward providing reasonable assurance that the sector's allocations can be attained at some point in the future by reducing the extent of the retrofits that would be required to attain the allocations. As discussed below in Section VI, the correct starting point for developing increased allocations for the urban runoff sector would be for EPA to use the James River allocations in the 2005 Tributary Strategies rather than the allocations proposed in the TMDL. The urban runoff sector allocations derived from the Tributary Strategies would have to be significantly higher than those currently proposed by EPA if the Localities are to have any chance of achieving their allocations by 2025. Even with significantly higher allocations, however, it is unlikely that the Localities and private property owners would be able to implement all of the required retrofits by EPA's 2025 deadline because in addition to installing retrofits on public land and requiring retrofits on private land as re-development occurs, the Localities would also have to acquire easements to install retrofits on private land that was not undergoing re-development. As explained in these comments, easement acquisition is an extraordinarily time-consuming and expensive process.

Finally, given the immense costs and difficulty of attaining the urban runoff sector allocations, it is remarkable that the TMDL reflects so little interest on the part of EPA in seriously considering and pursuing additional, more cost-effective opportunities to achieve the basin-wide allocations. While assigning allocations to load reductions attributable to filter feeders such as oysters and menhaden would not provide reasonable assurance that the urban runoff sector allocations can be achieved, it would provide some relief to the impossible burden that the TMDL would impose on the Localities. Also, EPA has failed to aggressively target air deposition in the TMDL for greater load reductions. Atmospheric sources are estimated to account for about one-third of the nitrogen loading to the Bay, yet the TMDL simply accepts existing and planned air regulatory programs as an appropriate level of effort to reduce nitrogen loads from air deposition, much of which originates from outside of the Bay watershed. An aggressive, targeted approach to this large source sector would free-up allocations for the urban source sector, making it more likely that this sector's allocations could be attained at some point in the future.

## III. EPA DOES NOT HAVE THE LEGAL AUTHORITY TO ESTABLISH A DEADLINE IN THE TMDL

Nothing in either section 303(d) of the Clean Water Act (CWA) or its implementing regulations gives EPA the legal authority to set a deadline for attainment in the TMDL, nor has EPA cited to any such authority in the TMDL.[7] EPA's proposed

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the load reductions required of the urban runoff sector should be far less than the load reductions required of the agriculture sector. An analysis of the James River sector allocations shows that the level of effort required of the agriculture sector to achieve its allocations is considerably less than the level of effort required of the urban runoff sector to achieve its allocations.

[7] EPA's own guidance effectively acknowledges that it lacks the authority to impose a compliance deadlines in TMDLs. See New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs), Memo from Robert Persciasepe, 4 (Aug. 8, 1997) (stating that "Section 303(d) does not establish

2025 deadline would establish a single schedule in the form of a deadline for achieving compliance with the allocations for all NPDES permitted sources within the Chesapeake Bay watershed. Such a deadline is in direct conflict with EPA's own regulations, which authorize compliance schedules in NPDES permits, not TMDLs. See 40 C.F.R. § 122.47 (providing that a "permit may, when appropriate, specify a schedule of compliance leading to compliance with CWA and regulations.") While this may be EPA's TMDL, it is for the states with delegated NPDES permit programs, not EPA, to establish schedules and deadlines for achieving compliance with the allocations in the TMDL. See 40 C.F.R. § 123.25; 40 C.F.R. § 130.5(b)(1).

It is also well established that schedules of compliance to implement state water quality standards are purely matters of state law, which EPA has no authority to override. See In the Matter of Star-Kist Caribe, Inc., NPDES Appeal No. 88-5, 4 EAB 33, 36 (EAB 1992) (the responsibility of [s]tates under the law to make specific provision for schedules of compliance … is unequivocal"); In re District of Columbia Water and Sewer Authority, NPDES Appeal Nos. 05-02, 07-10, 07-11, and 07-12, EAB 714, 734 (EAB 2008) ("it is the role of the states, not EPA, to determine whether and under what circumstances compliance schedules may be incorporated in NPDES permits.") Therefore, EPA's attempt to establish a compliance deadline in the TMDL has no basis in the CWA or its implementing regulations, and improperly seeks to override the discretion reserved to the states to establish appropriate schedules of compliance on a case-by-case basis. Thus, the 2025 deadline should be removed from the TMDL.

Aside from the question of EPA's legal authority to establish a deadline in the TMDL, the 2025 deadline would have significant consequences for the Localities because it would directly impact their MS4 programs and their ability to comply with their future permits should the permits contain, as expected, Bay TMDL-derived conditions based on the deadline. The other source sectors would be largely unaffected by the 2025 deadline. Municipal and industrial wastewater treatment plant upgrades are generally completed within the five-year terms of their permits, and while the widespread implementation of agricultural BMPs and onsite septic system retrofits may be a long-term undertaking, the deadline would not expose these largely unregulated sources to either the added costs of attempting to attain the allocations by an enforceable deadline or the risk of enforcement for permit non-compliance. The 2025 deadline would expose the Localities, on the other hand, to future NPDES permits containing retrofit implementation schedules that, as explained above, would, at a minimum, dramatically increase their compliance costs, or more likely, would be unattainable despite their best efforts to achieve compliance by the deadline.

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any new implementation authorities beyond those that exist elsewhere in State, local, Tribal or Federal law").

## IV. EPA HAS FAILED TO PROVIDE THE LOCALITIES WITH A REASONABLE OPPORTUNITY TO REVIEW, EVALUATE, AND COMMENT ON THE BASIS FOR THE PROPOSED ALLOCATIONS.

### A. The length of the comment period is insufficient given the size of the docket and the complexity of the TMDL.

Although EPA has characterized this as the largest and most complex TMDL ever developed, it is providing only a 45-day period to review and comment on the over 2,000 pages of documents posted on the docket. While we recognize that EPA has a certain amount of latitude in establishing the length of its comment periods, we submit that in this case, EPA has abused its discretion and effectively deprived stakeholders such as the Localities with a reasonable opportunity to comment on this very complex and controversial proposal.

The 45-day comment period is inconsistent with Executive Order 12866, which provides that most rulemakings should include a comment period of not less than 60 days, as well as EPA's own Public Involvement Policy, which stipulates that "the comment period for public review of unusually complex issues or lengthy documents generally should be no less than 60 days".[8] Further, even a 60-day comment period would be too short in this case as reflected in the fact that EPA has established comment periods longer than 60 days for large, complex or controversial proposals such as this TMDL. Examples include EPA's 2010 proposed Water Quality Standards for Florida's Lakes and Flowing Waters (90-day comment period); EPA's 2009 proposed Renewable Fuel Standard (120-day comment period); EPA's 2001 proposed Electronic Reporting Rule (180-day comment period).

### B. The opportunity for comment is limited further by EPA's failure to provide all the information and tools needed to review and evaluate the TMDL.

Despite the massive size of the docket, EPA has not provided the public with all of the information and tools needed to effectively review, evaluate and comment the on basis for the proposed allocations. This is also inconsistent with EPA's Public Involvement Policy, which provides that "the comment period should not open until materials are available for the public to obtain and review".[9] The Localities have tried to overcome this impediment to their opportunity to comment, in part, by posing several written questions and requests for information to EPA in an effort to gain a better understanding of the basis for the urban runoff allocations, but EPA has been generally unresponsive to these questions and requests.

Particularly significant is EPA's failure to make critical components of its TMDL decision support system, such as the Scenario Builder software and reliable Phase 5.3

[8] See Public Involvement Policy of the U.S. Environmental Protection Agency (EPA 233-B-03-002 - May 2003) at page 13.
[9] Id.

Model source codes and data, available to the modeling community outside of EPA. Without access to these components, modelers retained by stakeholders such as the Hampton Roads Localities must blindly accept model inputs from EPA and must rely upon EPA to stitch together various patches and workarounds to get the Model to run. This has the effect of making an already inadequate 45-day comment period even shorter as modelers outside of EPA are forced to wait for EPA to run the Model and produce the results, leaving them without adequate time to evaluate and understand the data. Under these circumstances, there is little that the modeling community can do to apply the Phase 5.3 Model in any independent or meaningful manner within the very limited period of time provided by the comment period.

Further, although experts have previously reviewed portions of the Phase 5.3 Model code and data, substantial amounts of the current modeling code and data have been produced at breakneck speed with little or no verification either by the experts who checked portions of earlier versions of the code or by engineers or scientists in academia or the private sector. EPA's blind adherence to an artificial schedule and rollout of the Model and data has effectively prevented—and will continue to prevent—modelers outside of EPA from using the Model to:

- Understand how the complex physical processes are being modeled,
- Validate or check model input or output data,
- Use the Model to analyze pollution treatment alternatives such as BMPs, or
- Contribute to debugging and improving the Phase 5.3 Model through any meaningful testing and feedback processes.

Additionally, as explained below in Section VI, EPA's failure to make available post-processing performed on all of the chlorophyll-a modeling scenario runs has made it extremely difficult for the Localities' consultants to evaluate and comment on the differences in the model runs.

Finally, EPA has not mapped the data used in the Model despite requests for such mapping from the Virginia Department of Conservation and Recreation. The requested mapping would indicate locations of various urban land use categories (such as Impervious High Intensity, Impervious Low Intensity, Pervious High Intensity, and Pervious Low Intensity) used in the Phase 5.3 modeling. Likewise, there is very little documentation that would allow modelers outside of EPA to ascertain specifically how the data was collected and synthesized, which makes working with the Phase 5.3 Model a shot-in-the-dark proposition at the state and local levels. A single scenario run of the Phase 5.3 Model involves hundreds of input data files and produces some 60,000 intermediate and output files. Geographic Information System technology is best used to map this type of data to its sources, but without mapping, there is no way to ensure that sheep are not modeled as grazing in downtown areas, or that urban areas are not modeled as forest (both of which anomalies have been discovered in the Phase 5 model).

## V. THE PHASE 5.3 MODEL AND MODEL INPUTS ARE NOT SUFFICIENTLY DEVELOPED TO PRODUCE RELIABLE PREDICTIONS

### A. EPA has rushed the Model into service, and in the process has failed to comply with its own quality control standards.

EPA's suggestion that the public and the regulated community should have confidence in the accuracy of the model predictions and resulting allocations because "[t]he TMDL uses a series of models, calibrated to decades of water quality data and other data, and refined based on input from dozens of Chesapeake Bay scientists" (see TMDL Report at page iv) is misleading. While this may be the case for the other models used to develop the TMDL, it is not true for either the Phase 5.3 Watershed Model or its inputs, which are critical elements in the decision support system used by EPA to develop the proposed allocations. The Phase 5.3 Model undoubtedly has greater capabilities than previous versions of the watershed model, but the Model is new, and in its headlong rush to complete the TMDL by an artificial deadline, EPA is using the Model before it is fully calibrated and before verifying the accuracy of the land use inputs to the Model. In fact, EPA has effectively acknowledged that the Model is not ready to produce reliable predictions by its inability to establish the TMDL without a five percent "allocation reserve," its announced intention to begin recalibrating the Model in October 2010 (after the TMDL is released for public comment), and its use of ranges of sediment loading numbers (rather than a single number) for each basin allocation because the Model is unable to match observed data for sediment loading.

EPA has developed many large, complex computer programs and systems that have been tested, improved, and applied by the engineering and scientific community. Recognizing the importance of quality control and quality assurance processes in the development and application of its environmental programs, EPA's Office of Environmental Information Quality Staff published a *Quality Manual for Environmental Programs* (http://www.docstoc.com/docs/594179/EPA-Manual-EPA-Quality-Manual-for-Environmental-Programs) in May 2000. The primary goal of this manual is, "[t]o ensure that environmental programs and decisions are supported by data of the type and quality needed and expected for their intended use, and that decisions involving the design, construction, and operation of environmental technology are supported by appropriate quality assured engineering standards and practices." In this case, EPA has failed to meet the standards it set for itself in the Manual.

### B. The Model does not produce consistent, reliable results.

The Localities are not suggesting that there must be absolute precision in the Model's predictive capability. However, given the significant widespread financial consequences of even small changes in the Model's outputs, the Localities have every right to expect the accuracy of the Model inputs to be verified and the Model to be fully calibrated so that it produces consistent predictions within a reasonable margin of certainty before the Model is used to develop the TMDL.

The Model's inability to produce consistent predictions is further evidence that it is not ready to be used for TMDL development. EPA distributes the Phase 5.3 Model program in un-compiled form, meaning that in order to run the model users must obtain a FORTRAN compiler and generate the executable computer programs from the source code. However, there is a known and still unresolved problem with the Model producing different results when compiled on different computers. Identical input data was run on different computers in August 2010 for the James, York, and Rappahannock river basins, and the Phase 5.3 Model produced significantly different results, with variations in the answers as high as 36 percent. The reliability of the Model cannot be corroborated until repeatable results can be produced. EPA indicates that it is working on this problem, but again, the demands of EPA's self-imposed deadline to establish the TMDL far exceed the time required to produce a reliable watershed model and modeling results. Development of the Phase 5.3 Model is undoubtedly an ambitious and worthwhile undertaking, but a reasonable amount of time has to be devoted to testing and refining the Model to the point where it can be reliably used to justify billions of dollars in expenditures.

The implications of EPA's rush to establish the TMDL before the Model and model inputs are significant. Many of the allocations are targeted to pollutant reduction levels that are considerably less than the margin of uncertainty in the modeling process itself. As a consequence, the TMDL likely will burden the Localities and many others with extraordinary costs that do not produce a measurable water quality response. Dr. Kathy Boomer[10] of the Smithsonian Environmental Research Center has conducted specific research and noted that the margin of uncertainty in the TMDL component models was much greater than the pollutant loading reductions being sought. Dr. Ken Reckhow with Duke University[11] (who chairs the National Academy of Sciences Panel on the Evaluation of Chesapeake Bay Progress Implementation for Nutrient Reduction to Improve Water Quality) notes that TMDL prediction uncertainty is high, and has repeatedly cautioned regulators against reporting modeling results without stipulating the uncertainty. The Localities request that EPA report the uncertainty of the model in the documentation submitted with the final TMDL.

Unfortunately, it is apparent that EPA is intent on papering over the uncertainty in the modeling results and its consequences as reflected in the following from Section 5 of the TMDL Report:

> *Models have some inherent uncertainty. Because of the amount of data and resources taken to develop, calibrate, and verify the accuracy of the Bay models, the uncertainly of the suite of models is minimized.*

Quite the opposite is true - the amount of data and complexity of the system work to <u>increase</u> the uncertainty.

[10] <u>See</u> http://vimeo.com/12080139
[11] <u>See</u> http://www.rti.org/page.cfm?objectid=8C8E7BCD-5056-B100-0CC50391AF13C8C4

### C. The Model does not accurately predict the true extent of the TMDL's burdens on the Localities and resulting water quality benefits.

As explained above, the average 54 percent (James River) and 59 percent (York River) load reduction needed to achieve the backstop allocation for phosphorus would require treatment of approximately 68 to 74 percent of the urban area in the Hampton Roads Localities at a total estimated cost of approximately $9.8 billion plus the costs of land acquisition. EPA concludes from its modeling predictions that this and the other load reductions called for in the TMDL will achieve compliance with the applicable water quality standards, but an analysis of the Model and its inputs indicates that the modeling predictions underestimate the extent of the load reductions that will be required of the Localities' MS4s and overestimate the resulting water quality benefits.

1. <u>Existing imperviousness is underestimated in the Phase 5.3 Model.</u>

EPA has acknowledged the inaccuracies in the land use data used in the Model by setting aside the five percent allocation reserve discussed above. However, this reserve hardly begins to account for the inaccuracies in the data. An analysis of representative Geographic Information System (GIS) land use data from eight of the Localities shows that the satellite imagery used by EPA for its land use inputs to the Model underestimates the extent of imperviousness in the Hampton Roads region by an average of approximately 48 percent. <u>See</u> **Exhibit D**. The imperviousness data in the Localities' GIS systems is more accurate than the satellite imagery relied on by EPA, but EPA's TMDL development schedule did not allow time for EPA modelers to coordinate and collect this information from the Localities.

The implications of the underestimated extent of imperviousness are significant because it means that the Localities will have to reduce their urban runoff loads based on modeling data that assumes that they are substantially less impervious than they actually are. In other words, the land area that will have to be treated in order to attain the allocations is considerably greater than the approximate 68 to 74 percent of urban land area assumed in the financial impact analysis described above as will the costs and time required to attain the allocations.

2. <u>Groundwater is a substantial transport mechanism for nutrients into the Bay, but the Phase 5.3 Model lacks a groundwater transport capability.</u>

The Phase 5.3 Model does not contain a groundwater transport component - a significant deficiency because groundwater transport of nutrients is a major source of nitrogen loads discharged to the Bay. As noted on the Chesapeake Bay Program's web site[12]:

> *According to a 1998 study by the U.S. Geological Survey (USGS), groundwater contributed nearly half (48 percent) of the total nitrogen load to streams in the Bay watershed.*

[12] Source: http://www.chesapeakebay.net/groundwater.aspx?menuitem=14716

> *Groundwater contributes to river flow, or the amount of fresh water flowing from streams and rivers into the Bay. In a 1998 study, the USGS found that in an average year, of the 50 billion gallons of streamflow that enter the Bay each day, nearly 27 billion gallons are from groundwater. It can take years for groundwater — and the pollutants it may carry — to slowly travel through aquifers before reaching the streams and rivers that flow to the Bay. This "lag time" can make it difficult to determine whether efforts to reduce pollution throughout the Bay watershed are having a positive effect on the Bay's health.*

Ironically, many of the controls that will be employed to achieve the urban runoff load reductions needed to comply with the allocations in the TMDL are based on removal of pollutants by infiltration. Nitrogen and phosphorous are elements, and as such, they persist in nature. The absence of a groundwater component in the Model means that nutrient loads that are routed into infiltration BMPs magically disappear from the computational universe, when, in reality, they are deposited into groundwater that eventually flows into the Bay.

## VI. THE MODELING PREDICTIONS DO NOT JUSTIFY USE OF THE CHLOROPHYLL-a CRITERIA AS THE BASIS FOR THE JAMES RIVER BASIN ALLOCATIONS

Subsection 303(d)(1)(C) of the Clean Water Act requires that TMDLs be established at a level necessary to implement the applicable water quality standards. Here, EPA is proposing to establish the TMDL at a level that it asserts is necessary to implement the tidal James River seasonal chlorophyll-a criteria. In so doing, it is proposing to establish the TMDL at a level for the James River basin that will require significantly greater load reductions and costs than would be required to implement the dissolved oxygen and water clarity criteria for the James River and main-stem of the Bay.[13] EPA may have acted within the scope of its authority in considering the chlorophyll-a criteria as the "applicable water quality standards" for the James River. However, it has failed to offer a reasoned justification for using the chlorophyll-a criteria as the basis for the James River allocations in light of significant unresolved issues

[13] As discussed below, the Localities maintain that EPA should replace the allocations proposed in the TMDL for the James and York river basins with the allocations in the 2005 James River and York River Tributary Strategies. The Tributary Strategies reflected the Chesapeake Bay Program's determination that nutrient loadings from these basins have little impact on dissolved oxygen levels in the main-stem of the Bay and that the additional nutrient controls called for in the Tributary Strategies were required for local water quality needs only. Studies conducted since 2005 confirm that this is still the case. Hence, in the absence of a stable, calibrated chlorophyll-a model for the James River, the Tributary Strategies' allocations continue to reflect the best science available for establishing allocations for the James and York river basins. Comments on the TMDL submitted by the Virginia Association of Municipal Stormwater Agencies (VAMSA) contain a more extensive and detailed analysis of this issue. In the interest of brevity, the Localities adopt and incorporate VAMSA's comments and attached exhibits and appendices by reference rather than repeating them here.

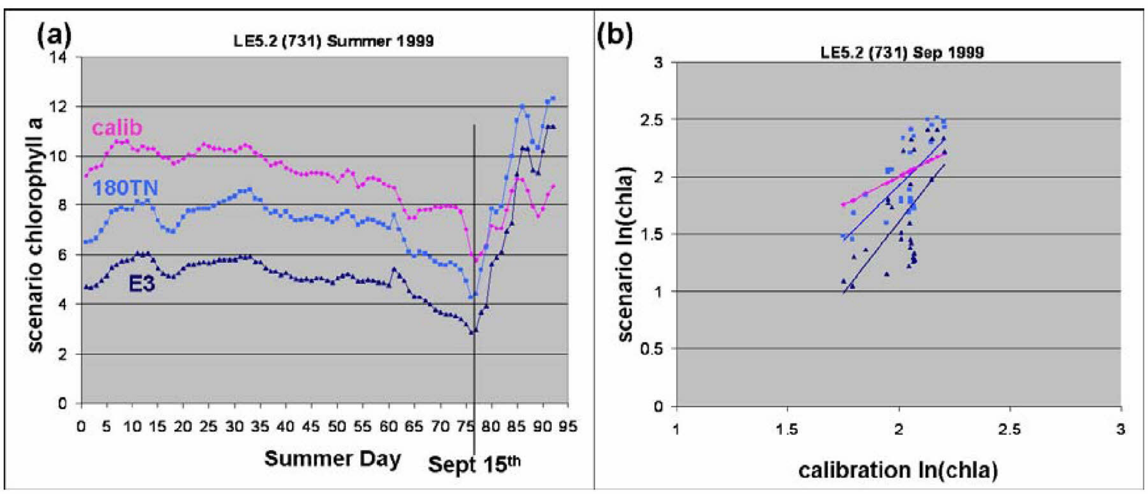
related to the accuracy of the chlorophyll-a modeling predictions and resulting absence of any quantifiable water quality benefit from the billions of dollars in additional expenditures that will be required to meet the proposed chlorophyll-a criteria-based allocations.

### A. The chlorophyll-a water quality model is not stable, not calibrated properly, and should not be used to establish the TMDL allocations.

Since 2009, the regulated community has urged EPA to address significant issues relating to the accuracy of the chlorophyll-a modeling predictions, including erroneous calibration in certain segments and seasons, model post-processing problems, unexplained model anomalies, and the improper use of data.[14] EPA has not only failed to undertake the systematic review and analysis of the model's predictive capabilities needed to fix these problems, it has improperly manipulated the model. Specifically, while EPA was attempting calibrate the model, it found that when using data from the September 1999 timeframe, chlorophyll-a concentrations were going up rather than going down as loads were reduced as shown in **Figure 1**. But rather taking the time to find and correct the source of the problem, EPA simply eliminated the September 1999 data to produce the result it was seeking. EPA has offered no explanation for why the model was not working properly nor has it offered a justification for deleting the data. If EPA is going to disqualify data, it should at least explain why it is being disqualified.

**Figure 1[15]**

**"Anomaly in some driver of the model simulation that caused poor scenario performance in the latter half of September 1999 at LE5.2"**




[14] See letter dated August 16, 2010 and attachments from the Virginia Association of Municipal Wastewater Agencies (VAMWA) to EPA, which is attached to and incorporated in these comments as **Exhibit E**.

[15] From TMDL Report, Appendix O, Figure 6. Plot of simulated surface chlorophyll a concentrations for WQM cell 731 (location of station LE5.2) during the summer of 1999 (a), and resulting regression plot for September 1999 LE5.2 chlorophyll a (b). The quote in Figure 1 is from Appendix O, pg O-5.

Further, EPA provided no reasonable explanation for why the chlorophyll levels increased with decreasing nutrient loads. EPA should recalibrate the model and explain the cause of the model errors. Until EPA recalibrates the model and the model is verified with enough peer review to ensure appropriate reliability in establishing reasonable allocations for the James River basin, the allocation should remain at the "Tributary Strategy" level for the reasons discussed below.

### B. EPA has failed to provide documentation related to post-processing of the data.

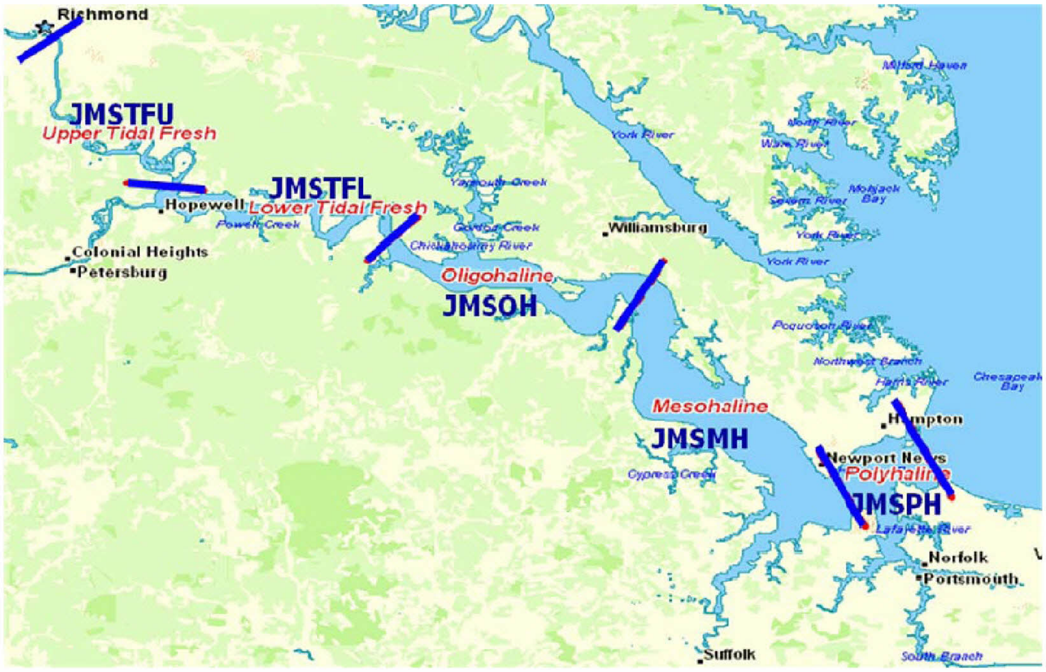
EPA has made it extremely difficult to evaluate the differences between the chlorophyll-a model runs. In Appendix O to the TMDL Report, EPA only states that it post-processed (manipulated) the data to address the poorly performing model results associated with the "James LOE ½ Potomac" model scenario. However, based on a review of EPA's "stoplight plots" for chlorophyll-a in Table M3 of Appendix M to the TMDL Report, it appears that EPA post-processed only the "James LOE ½ Potomac" scenario and failed to post-process the remaining scenarios. Scenarios with higher allocations in the James River should have been post processed and published to allow public review of the results and the relative attainment rates for different load allocations.

**Exhibit F**[16] includes a series of four tables ("stoplight plots") for the "91-00 Base", "Tributary Strategy", "190/12.7 Loading", and "James LOE ½ Potomac" scenarios for each of the three-year rolling average for the periods between 1991 through 2000 that EPA uses to assess compliance. Each table includes percent non-attainment of the chlorophyll-a water quality criteria for each of the five model segments of the James River shown in **Figure 2**. The blacked data points shown in **Exhibit F** for the JMSTFL and JMSPH segments in the "James LOE ½ Potomac" model scenario represent chlorophyll-a model output that was not considered reliable by EPA. Once post-processing of the data was completed, the JMSMH segment showed only 1% non-attainment, which EPA indicated was sufficient to establish the James River basin allocations for TN and TP loads at 23.5 and 2.35 million pounds per year, respectively. However, there are no records in the TMDL Report or its appendices for the percent non-attainment for the JMSMH segment prior to the post-processing for the '97-'99 or '98-'00 summer periods shown in **Exhibit F**. Therefore, we have undertaken the following analysis of the data to compare the scenarios.

[16] Data extracted from Table M3 of Appendix M to the TMDL Report.

**Figure 2**

**James River Model Segments**




EPA's PowerPoint presentation in early summer 2010 showed the percent non-attainment rates for the "190/12.7 Loading" scenario after post-processing of the model results. **Exhibit G** shows the same four scenario tables ("stoplight plot") as provided in **Exhibit F**, except the post-processing of the data for the "190/12.7 Loading" scenario was applied based on the EPA's June 2010 presentation. **Exhibit G** shows that JMSTFL and JMSPH segments were also not considered reliable by EPA and removed from consideration. EPA reported that the percent non-attainment for the JMSMH segment was reduced from 15 percent in **Exhibit F** to 4 percent in **Exhibit G**, which was based on the EPA's removal of the problem regression data. It is reasonable to assume that the same trend would exist for the "Tributary Strategy" Scenario as shown in **Exhibit G**. The post-processed "Tributary Strategy" percent non-attainment rate for the JMSMH segment would be expected to be about 1 percent higher than the "190/12.7" scenario (based on comparison between **Exhibit F** and **Exhibit G**). Therefore, it would be expected that the "Tributary Strategy" data would attain the standard about 93 to 94 percent of the time. The difference between this attainment rate and the one percent attainment rate that EPA used to develop the proposed allocations is inconsequential considering the fact that (1) EPA has failed to fix the flaws in the model and has had to improperly manipulate the data to make it work, and (2) the difference in modeled chlorophyll-a concentrations between the two scenarios is so small that it is likely to be undetectable.

EPA has indicated that the "190/12.7 Loading" scenario is needed to meet the dissolved oxygen water quality standard in the main stem Chesapeake Bay. However, the 2005 James River Tributary Strategy loading was established based on the chlorophyll-a criteria, which was well below what was required to comply with the dissolved oxygen standard in the main stem Chesapeake Bay. Additionally, it is well known that the James River has little impact on the Chesapeake Bay given its proximity to the Atlantic Ocean. EPA should provide a model run that keeps all the other segments at the allocations associated with the "190/12.7 Loading" scenario, but increase the James River basin loadings to 27.5 and 3.3 million pounds per year for TN and TP, respectively. It is expected that this model scenario will show that the Tributary Strategy loading in the James River basin will not have a material or measurable impact on the dissolved oxygen in the Chesapeake Bay. Therefore, the allocations for the James River Basin should remain at the "Tributary Strategy" loadings.

### C. A knee-of-the-curve analysis further indicates that the James River allocations should be based on the Tributary Strategy

We recognize that EPA has a certain amount of discretion to rely on model predictions as the basis for its TMDLs, even when the predictions are acknowledged to reflect some uncertainty. However, there are limits to the exercise of that discretion; and this is one instance where EPA would be acting arbitrarily because in addition to unresolved flaws in the model, the model predictions are unable to reliably distinguish between model scenarios with immense cost implications as shown in the following knee-of-curve analysis, which was prepared by one of the Localities' consulting engineers, Greeley and Hansen.

**Figure 3**

**Knee-of-the-Curve Analysis for James River Chlorophyll-a WQS**

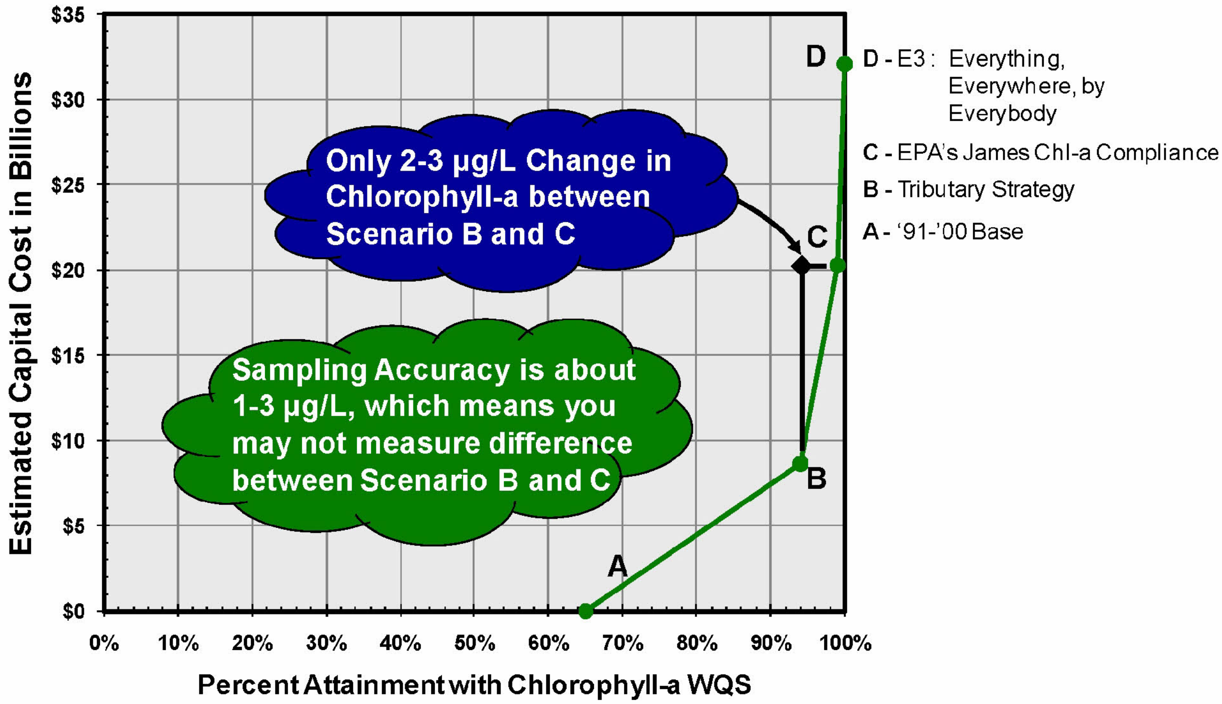



**Figure 3** shows the estimated capital costs of attaining the chlorophyll-a criteria against the percent attainment rate. The capital costs include estimates for basin-wide wastewater treatment plant reductions, agricultural BMPs, and urban runoff controls necessary to meet the allocations identified by EPA for the scenarios identified in **Figure 3**. The wastewater treatment plant capital costs are a function of design flows and level of treatment (biological nutrient removal, enhanced nutrient removal and limit of technology). Agricultural capital costs are based on BMP unit cost per acre and the BMP assumptions used in the Phase 5.3 Model. The urban runoff capital costs[17] are based on the performance associated with the runoff reduction method for an estimated amount of retrofit controls that could be installed in a locality, which represents only a portion of the urban runoff costs. The costs for the remainder of the urban runoff reductions needed to meet the allocations would be achieved with storage and reuse. The estimated capital costs were prepared for the following EPA Scenarios:

[17] Urban nutrient management was not included. The capital costs are based on meeting the waste load allocation for the Urban Runoff identified in Appendix Q-1 of the TMDL report.

- ’91-’00 Base Scenario: Point “A” represents the James River TN and TP loading of 36.9 and 3.3 million pounds per year, respectively.

- EPA’s Tributary Strategy: Point “B” represents the James River TN and TP portion of the Bay-wide loading, which is 27.5 and 3.3 million pounds per year, respectively.

- EPA’s James Chl-a Compliance: Point “C” represents the James River TN and TP loading of 23.5 and 2.35 million pounds per year, respectively. EPA has selected this scenario as the basis for compliance with the James River chlorophyll-a criteria. EPA also refers to this scenario as “James Level of Effort at ½ Potomac”. In Appendix J to the TMDL Report, EPA states “In the James, the nutrient loads are equivalent to the level of effort half way between Virginia’s portion of the Potomac and the James for the 190/12 Loading Scenario.”

- E3 (Everything, Everywhere, by Everybody): Point “D” represents the James River TN and TP loading of 16.1 and 1.5 million pounds per year, respectively. EPA considers this to be the “theoretical maximum levels of managed controls on all pollutant load sources”. There are no cost and few physical limitations to implementing controls for point and nonpoint sources in the E3 scenario. This scenario is used with the No-Action scenario to define the “controllable” loads, i.e., the difference between No-Action and E3 loads.” See TMDL Report at Appendix J.

The knee-of-the-curve analysis determines where the increment of pollution reduction achieved in the receiving water diminishes compared to the increased costs. There is a steep inflection at Point “B” that represents the knee-of-the-curve. Any reduction beyond Point “B” lacks a viable cost-to-benefit ratio and does not reflect a reasonable level of attainment. EPA has selected Point “C” as the basis for the James River compliance with the chlorophyll-a criteria, which is about half way between Point “B” and EPA’s E3 scenario (Point “D”). If one assumes that the model predictions are accurate (about which there is substantial doubt), at Point “B”, the James River would be 93 to 94 percent compliant with chlorophyll-a criteria compared to 99 percent at Point “C”. However, the true difference in chlorophyll model output between Points “B” and “C” is only 2 to 3 μg/L (three parts in a billion). Additionally, the sampling and testing accuracies for physical water measurements is 1 to 3 μg/L. In other words, even if the loadings between Points “B” and “C” were achieved, it is unlikely that the difference in James River chlorophyll-a concentrations could be measured. The difference in the estimated cost of achieving the loadings between Points “B” and “C”, on the other hand, is over $10 billion.

In summary, it is incumbent upon EPA to reconsider the basis for the James River allocations considering the magnitude of the costs of attaining levels of load reductions required to produce a difference in modeled chlorophyll-a concentrations so small that they cannot be reliably measured,. At a minimum, EPA should not pass the knee-of-the-curve identified at Point “B” of the above graph. Assuming there is any water quality improvement beyond Point "B", it would not be cost effective, could not be physically measured, and could not be reasonably attained. Therefore, James River basin allocations should be based on the Tributary Strategy allocations.

## VII. CONCLUSIONS AND RECOMMENDATIONS

EPA has promoted the Bay TMDL as employing an adaptive management approach to restoring the Bay and protecting the James River, yet its approach to establishing the allocations reflects anything but an adaptive approach. Rather than calling for incremental additional load reductions that account for the unresolved significant questions surrounding the accuracy of the chlorophyll-a modeling predictions and the absence of any quantifiable benefit from achieving load reduction greater than those called for in the James River Tributary Strategy, EPA appears to be determined to press ahead with proposed allocations that call for load reductions that may go well beyond those needed to restore the Bay and protect the James River. Adaptive management avoids wasted time and money by providing for the incremental commitment of resources until the applicable water quality standards are attained. EPA's approach will not achieve compliance with the standards any earlier, but it does pose a serious risk that the Localities and other sources in the James and York river basins will expend far more resources than needed to attain the applicable water quality standards.

If EPA is truly committed to an adaptive management approach to the TMDL, it will establish the TMDL based upon the allocations in the Tributary Strategies while working with the modeling community to address the unresolved issues with the Phase 5.3 Model and the chlorophyll-a modeling predictions. Once these issues are resolved, the TMDL can be updated and modified, if necessary, to reflect allocations based on a fully developed and calibrated Phase 5.3 Model, verified model inputs, and model predictions that (unlike the current predictions) do not have to be manipulated to produce results consistent with the observed data. In the meantime, progress toward attainment of the applicable standards can continue. Much remains to be done to attain the Tributary Strategies allocations so no time will be lost while the work needed to make the Model reliable enough to establish TMDL allocations and fix the model inputs continues,

The approach we recommend would achieve our mutual water quality goals for the Bay more efficiently, cost-effectively, and quickly by fostering the federal, state, and local partnership that is so critical to an undertaking of this magnitude. EPA's adherence to an artificial deadline for establishing the TMDLs and its heavy-handed approach to date serves only to undermine that partnership and create distrust and resistance on the part of those who must bear the burdens of achieving the load reductions required to restore the Bay and protect the James River.

Finally due to the 64,000 square-mile extent of the Model, there is an inherent problem of scale when addressing urban runoff controls. The Model is better suited for overarching computations on larger scales, such as evaluating the effects of fertilizer applications on large segments of the Bay watershed, than it is in evaluating the effects of a particular control or group of controls on specific sites. EPA has acknowledged that the effects of individual, site-specific controls cannot be directly addressed in the Phase 5.3 Model.[18] Therefore, we recommend that EPA develop guidance for localities that will allow them to evaluate specific alternative controls consistent with the Phase 5.3 modeling. Such guidance would require EPA to overcome the inherent scale problem in the Phase 5.3 model, problems with BMP efficiency rates, problems with sorting out and correcting the modeling data, and would allow the Localities and other localities with MS4s to make informed, intelligent decisions without requiring them to translate this very complicated technology completely on their own.

[18] EPA Chesapeake Bay TMDL March 25, 2010 Webinar

# REGIONAL COOPERATION IN STORMWATER MANAGEMENT

## FISCAL YEAR 2009-2010

## A STATUS REPORT

**This report was included in the HRPDC Work Program for FY 2010-2011, approved by the Commission at its Executive Committee Meeting on June 16, 2010**

**Prepared by the staff of the
Hampton Roads Planning District Commission
in cooperation with the
Regional Stormwater Management Committee**

**September 2010**

# REPORT DOCUMENTATION

**TITLE:**
**Regional Cooperation in Stormwater Management Fiscal Year 2009-2010: A Status Report**

**REPORT DATE**
**September 2010**

**GRANT/SPONSORING AGENCY**
LOCAL FUNDS

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## ABSTRACT

This document describes cooperative activities related to stormwater management undertaken by Hampton Roads local governments during Fiscal Year 2009-2010. Activities described include the Regional Information Exchange Process, Public Information and Education, Legislative and Regulatory Issues, Cooperative Regional Studies and Related Programs and Projects in which the localities participate. One of a series of Annual Reports, this document is used by the region's twelve localities with stormwater permits to assist them in meeting their permit requirements.

## ACKNOWLEDGMENTS

The Hampton Roads Planning District Commission, in cooperation with the Regional Stormwater Management Committee, prepared this report.

Preparation of this report was included in the HRPDC Unified Planning Work Program for FY 2010-2011, approved by the Commission at its Executive Committee Meeting of June 16, 2010.

The sixteen member local governments through the HRPDC Regional Stormwater Management Program provided funding.

## INTRODUCTION

Working through the Hampton Roads Planning District Commission, the region's sixteen member cities and counties cooperated on a variety of stormwater management activities during Fiscal Year 2009-2010. This cooperative effort has been underway as a formal adjunct to the Virginia Pollutant Discharge Elimination System Permits (VPDES) for Municipal Separate Storm Sewer Systems (MS4) held by the Cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth and Virginia Beach since Fiscal Year 1995-1996. Cooperative activities documented in this report represent a continuation of an ongoing effort, which has involved concerted activity since 1992.

## REGIONAL STORMWATER MANAGEMENT PROGRAM GOALS

The HRPDC and the Regional Stormwater Management Committee undertook a comprehensive effort in FY 1998-1999, called the Regional Loading Study. This effort was completed in September 1999. The project included development by the RSMC of a set of regional stormwater management goals to guide the regional program. The goals were presented to and adopted by the HRPDC at its Executive Committee Meeting in September 1999. They were reaffirmed in the January 2003 approval of the "Memorandum of Agreement (MOA) Establishing the Hampton Roads Regional Stormwater Management Program" and the March 2008 renewal of the MOA. The adopted Regional Stormwater Management Program Goals, which guide the regional program, are:

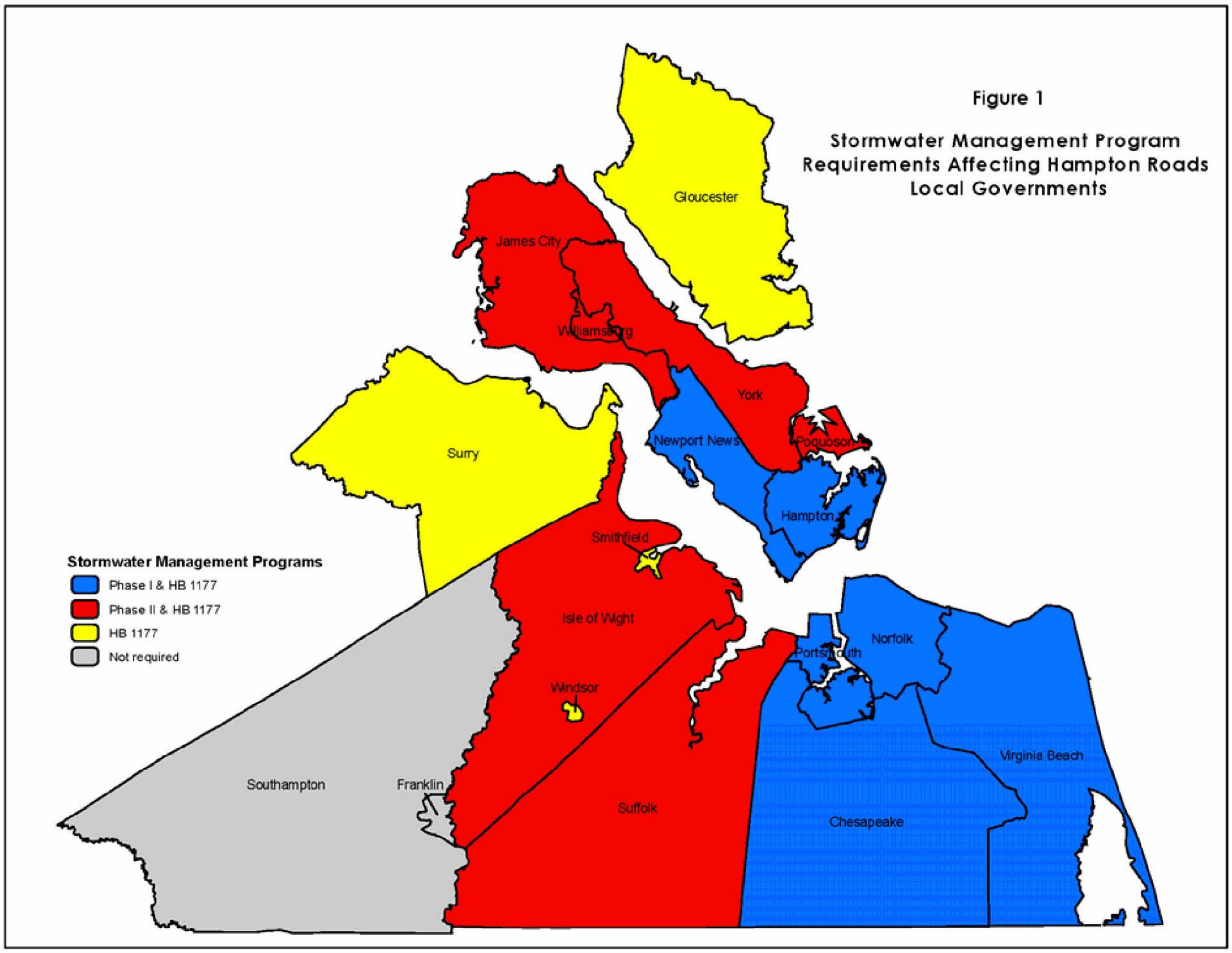
- Manage stormwater quantity and quality to the maximum extent practicable (MEP).
  - Implement BMPs and retrofit flood control projects to provide water quality benefits.
  - Support site planning and plan review activities.
  - Manage pesticide, herbicide and fertilizer applications.

- Implement public information activities to increase citizen awareness and support for the program.

- Meet the following needs of citizens:
  - Address flooding and drainage problems.
  - Maintain the stormwater infrastructure.
  - Protect waterways.
  - Provide the appropriate funding for the program.

- Implement cost-effective and flexible program components.

- Satisfy VPDES stormwater permit requirements.
  - Enhance erosion and sedimentation control.
  - Manage illicit discharges, spill response, and remediation.




## THE REGIONAL PROGRAM

The HRPDC Regional Stormwater Management Committee (RSMC) recommended during FY 1995-1996 that a formal regional program be established at the HRPDC, to be funded by the participating member localities for an initial period of up to three years. The program, established in July 1996, initially focused on activities that supported the permit compliance efforts of the six communities with Phase I VPDES Stormwater System Permits, technical assistance to the region's non-permitted communities and regional education and training to support all of the communities. Development and refinement of the regional program is a cooperative venture between the HRPDC staff and the Regional Stormwater Management Committee. The Regional Program is evaluated annually by the RSMC.

**PHASE I LOCALITIES**

The efforts of the Phase I localities have again this year centered on negotiating new permit conditions, as well as following the development of changes to the Virginia Stormwater Management Regulations. This intensive rule-making process has involved the work of various state-coordinated Technical Advisory Committees (TACs), in which several committee members and HRPDC staff have participated. In addition, a series of meetings between all of the Hampton Roads Phase I permitted localities, DCR and EPA has been the focus of much work of the committee and staff. Key permit issues have been resolved, while others remain under discussion. The anticipated final draft permit was not completed by the end of calendar year 2009 as expected and the state rulemaking process continues.

**PHASE II LOCALITIES**

In late 1999, the U.S. Environmental Protection Agency promulgated the final Phase II Stormwater Permit Regulations. To facilitate review of the regulations, the HRPDC staff prepared a "Review and Summary of the Regulations." That review summarized regulatory requirements, highlighted differences between the Phase I and Phase II regulations, noted potential issues that needed to be considered by the Phase II localities in determining their response to the regulations and suggested alternative approaches by which the region's localities could meet the new requirements in a collaborative fashion. That report served as the basis for the region's six Phase II localities moving forward in a cooperative fashion to address the Phase II Permit requirements.

The localities that are covered under Phase II of the Permit Program requested that the HRPDC facilitate a joint approach to development of their permit reapplications and stormwater management program plans, where applicable. Through this cooperative effort, the HRPDC developed a regionally consistent stormwater management program in cooperation with the affected localities. Ongoing activities under the Phase II Permits, which were reissued in 2008, are addressing program development and implementation in a cooperative fashion.

## INFORMATION EXCHANGE

The cornerstone of the Regional Stormwater Management Committee's activities continues to be the exchange of information. This is accomplished through regular monthly meetings to address topics of regional importance, as well as crosscutting issues that affect local stormwater, planning, public works and public utilities staff. In addition, various agencies and organizations utilize this regional forum to engage and inform local governments, as well as to gather feedback.

### Monthly Meetings

The sixteen communities are represented on the HRPDC Regional Stormwater Management Committee, which meets monthly. These monthly meetings provide an opportunity to exchange information about successful stormwater management techniques, program activities, utility structures and policies, and a myriad of related environmental issues. Cooperating agencies such as DCR, VDOT, HRSD and the US Navy regularly participate in these meetings.

The monthly meetings provide a forum for exchange of information and coordination among the permitted communities, while providing educational background and preparation for staff from the non-permitted localities. Several related state programs, including those implementing the Virginia Stormwater Management Act, Erosion and Sediment Control Law, and Chesapeake Bay Preservation Act, as well as the evolving Chesapeake Bay Program water quality studies, including Tributary Strategies and the delisting of the Bay and its Tributaries as "impaired waters," govern all of the localities. Increasingly, the region's localities are affected by and involved in the state's TMDL (Total Maximum Daily Load) Studies and Implementation Plan processes. Issues associated with these programs are also addressed during the monthly meetings.

During FY 2009-2010, representatives of the Regional Stormwater Management Committee participated with representatives of the other HRPDC Environmental Committees, in assisting the HRPDC staff to design its comprehensive work program. The HRPDC work program continues to include a strategic planning initiative, identified previously as a high priority activity by this group. The Committee continued the long-term effort to better integrate the various reporting requirements associated with the state's stormwater management programs and to explore institutional approaches to further enhance the region's environmental planning and management programs.

## State and Federal Agency Program Briefings

Representatives of state and federal agencies frequently brief the Committee on developing issues, regulatory guidance and technical programs. During the year, the Committee was briefed regularly by representatives of the Virginia Department of Conservation and Recreation (DCR) on state initiatives related to the Virginia Stormwater Management Regulations, by representatives of the DCR Division of Chesapeake Bay Local Assistance on various aspects of the CBPA Regulations and associated guidance, by the U.S. Navy on their work, by DEQ staff on the TMDL process and by staff from DCR and DEQ concerning the Chesapeake Bay Program TMDL efforts.

The ongoing activities of both the York River Watershed Council and the Lower James River (Hampton Roads) Watershed Roundtable in support of related water quality initiatives were discussed. The Watershed Roundtable approach is Virginia's preferred approach to nonpoint source pollution management. All members of the RSMC participate in the Roundtables, along with representatives from other local government departments, regional and state agencies, Soil and Water Conservation Districts and private organizations.

## PUBLIC EDUCATION

## HR STORM

To support development and operation of the stormwater education program, a Public Information and Education Subcommittee consisting of local stormwater education/public information staff was established in 1997. The regional stormwater education program is known as HR STORM. The Public Information and Education Subcommittee (HR STORM) was established during FY 1997-1998 and meets on a monthly basis. The HR STORM Program and its accomplishments for the year are summarized in the HR STORM Program Report for Fiscal Year 2009-2010.

Program funding supports, in part, HRPDC staff members, who also coordinate the region's water conservation education program (HR WET), the regional litter control and recycling education program (HR CLEAN), the regional wastewater (fats, oil and grease) educational program (fatfreedrains.com), as well as other regional environmental education, public information and training programs. The HRPDC staff is facilitating a number of cooperative ventures among these programs, which serve to enhance the effectiveness of all of them. These joint ventures have come to be known as HR Green. In FY 2009-2010, an RFP was circulated for consultant services to assist in more effectively integrating the various educational messages. The firm of Cahoon & Cross has been selected and is currently working on an overall Communications Plan. More detail about this effort is provided in the HR STORM Annual Report.

## TRAINING

Since 2004, the HRPDC staff has worked with the six Phase II communities to develop and conduct training programs for local government staff. These programs are designed to assist the localities in meeting the Good Housekeeping Management Measure. Program topics are reviewed and prioritized annually by the Phase II Subcommittee. The HRPDC staff coordinated the logistical and technical aspects of two regional training seminars this year. The first, an Illicit Discharge Detection and Elimination training, was attended by over thirty local government staff members, representing 9 localities within the region. An additional field training on LID practices in the area was coordinated for Phase II localities and was attended by all of the Phase II permitees. Training topics will be reviewed and evaluated periodically. The next training planned will likely deal with municipal parks and open space management, based on the training priorities below, and is tentatively scheduled for Winter 2011.

| Topic | Last offered | Previous dates |
|---|---|---|
| Fleet Maintenance | Mar 2005 | |
| Landscaping | Mar 2006 | |
| IDDE | Oct 2009 | May 2007<br>Feb 2008 |
| General Pollution Prevention | Feb 2009 | Mar 2004 |
| Parks & Open Space Mgt. | | |
| LID Practices | June 2010 | |

## LEGISLATIVE & REGULATORY MONITORING

This element of the program involves monitoring of state and federal legislative and regulatory activities that may impact local stormwater management programs. Based on this monitoring activity, the HRPDC staff develops briefing materials for use by the localities, including consideration by the governing bodies. As appropriate, the HRPDC staff in cooperation with the Committee develops consensus positions for consideration by the Commission and local governments. The level of effort devoted to this element has increased significantly over the past four years. During FY 2009-2010, the regional emphasis was continued participation in the evolving regulatory stormwater program of the Department of Conservation and Recreation, associated guidance and pending regulations governing local stormwater management programs, permits for construction activities and permit fees.

The HRPDC staff participated on or monitored a variety of state Technical Advisory Committees (TACs) on behalf of localities impacted by various aspects of the Virginia Stormwater Management Program. Local government staff served on the Stormwater Management Regulations Technical Advisory Committee from June 2008 through September 2008. Staff continued to serve on the state BMP Clearinghouse TAC. This TAC was developed to review protocols for proprietary BMP pollutant removal efficiencies, and is a result of a similar regional effort explored by the HRPDC. The State testing and review protocol are currently in development, with recommendations from the TAC requiring approval by the SWCB.

Staff continued to monitor the Stormwater Regulation revision process through FY 2010. Staff and local governments attended meetings of the Virginia Soil and Water Conservation Board and DCR public hearings during Fall 2009 to provide comment and hear community input into the regulatory process. The HRPDC Commissioners were provided periodic updates on the process, as developments warranted.

## REGIONAL STUDIES

### Extreme BMP Makeover

HRPDC staff has assisted the Center for Watershed Protection with the Extreme BMP Makeover Project. The project involved a broad partnership among Virginia DCR, five early adopter communities and project partners with coordination and technical support provided by the Center for Watershed Protection.

The project emphasized the measurement and tracking of increased nutrient reduction by local communities at the site level through enhanced design of stormwater BMPs. A large portion of this work was incorporated into the revised Virginia Stormwater Management Program (VSMP) Permit Regulations Parts I, II, and III (4 VAC 50-60). While more accurate nutrient tracking systems were developed as a central element of the project, conservative initial computations suggest the project has significant nutrient reduction potential.

Norfolk, Portsmouth, Hampton, and James City County participated in the stormwater BMP survey component of the Study. Surveys were conducted in the Summer of 2008 and results were released in Spring 2009. In March 2010, HRPDC staff presented the Hampton Roads Regional Stormwater Management Program as an example of a monitoring consortium at the Rooftop to Bay Workshop held as part of this grant.

## Bacteria Source Tracking

Preliminary work was developed for a regional bacteria source tracking study. Top researchers will verify tracking protocol for the region to identify whether the bacteria sources are human, wildlife or domesticated animals. This information will enable future efforts to minimize bacteria in area waterways to be more effectively targeted. Dry weather sampling was conducted in Shingle Creek in Suffolk and Moores Creek in York County. Investigation of potential bacteria sources in Mill Dam Creek in Virginia Beach has continued over the last year. Wet weather sampling will occur as appropriate. The results of the Study are expected in the Summer of 2011.

## Stormwater Program Matrix

A comprehensive stormwater program matrix, including Phase I and Phase II communities, was developed which addresses both utility and programmatic issues. Staff endeavors to keep this information as up to date as possible.

## TECHNICAL ASSISTANCE

The HRPDC continues to serve as a clearinghouse for technical assistance to the localities, as well as a point of contact in arranging short-term assistance from one locality to another. The HRPDC Committee process also provides a forum, allowing state regulatory agency staff to meet with the region's localities to discuss evolving stormwater management and other environmental regulations. Comprehensive technical data and information is maintained in the HRPDC library for use by the participating localities as well as the public. In addition, the HRPDC staff provides technical information and advice to all of the participating localities on a wide variety of issues upon request. This past year, the HRPDC staff drafted a stormwater management program for the Town of Windsor, which adopted the program in January 2010. The HRPDC is also frequently requested by localities from other parts of Virginia and adjacent states for assistance due to its experience with stormwater management programs in Hampton Roads.

## MEMORANDUM OF AGREEMENT

The Regional Stormwater Management Program was established in 1996 as a formal program of the Hampton Roads Planning District Commission with support and participation from the sixteen member local governments. Due to increasing dependency upon the HRPDC to fulfill various permit requirements for both Phase I and Phase II localities, the HRPDC staff and RSMC developed a Memorandum of Agreement (MOA), formalizing the existing regional program, while providing a structure for future program evolution and regional cooperation. The MOA outlines the basic regulatory and programmatic premises for the cooperative program, incorporating the Regional Program Goals, outlined earlier in this report. It establishes a division of program responsibilities among the HRPDC and the participating localities and establishes the role and responsibilities of the Regional Stormwater Management

Committee. It formalizes the traditional method of allocating program costs, addresses questions of legal liability for program implementation and includes other general provisions. During this fiscal year, the MOA was reauthorized by the signatories.

## PERMIT ADMINISTRATION AND REPORTING SYSTEM (PARS)

In an effort to streamline reporting and capture data more effectively for local governments, the twelve permitted localities have pooled resources to develop the Permit Administration and Reporting System, or PARS. Based on local needs and anticipated Phase I permit requirements, as well as changes in the state stormwater management regulations, the region has contracted with URS Corporation to develop a web-based data tracking and reporting system. The first modules of the system are already being utilized by local governments to catalog development sites and their associated best management practices (BMPs). The system also enables localities to capture inspection information, as well as collecting documentation for future inspections or enforcement actions. In addition, localities can use the site to catalog stormwater outfalls, document illicit discharge investigations and record public education information. Users can then query a variety of reports to satisfy the reporting requirements of their stormwater permits. Future modules will be developed as more details of the state regulations and Phase I permits are finalized. It is anticipated that this system will serve as a model for statewide compliance.

## RELATED PROGRAMS AND PROJECTS

In various combinations, the twelve (12) MS4 communities, as well as their non-permitted counterpart communities, in Hampton Roads participate in a wide variety of related programs. These programs are noted here because of their relationship with stormwater management.

### Chesapeake Bay Program

Over the past several years, the Hampton Roads Region has devoted considerable attention to the ongoing Chesapeake Bay Program (CBP). To facilitate local government participation in Chesapeake Bay Program activities, HRPDC staff and RSMC members have participated in the deliberations of many CBP Committees and Work Groups dealing with urban stormwater, land development, watershed planning, land use development, modeling and local government's role in the Bay Program.

During the last year, staff has followed the EPA's development of the Chesapeake Bay TMDL by attending regularly scheduled webinars and conference calls of the urban stormwater workgroup. Staff also participated in Virginia's efforts to create its Watershed Implementation Plan for the Chesapeake Bay through attending the Stakeholder Advisory Group meetings and the stormwater workgroup meetings from December 2009 through August 2010.

## Chesapeake Bay Preservation Act Program

Fourteen of the sixteen member localities, including the six cities with Phase I MS4 Permits and the six localities with Phase II MS4 Permits, continue to implement programs in response to the Virginia Chesapeake Bay Preservation Act. Stormwater management is one component of those programs. Although the CBPA is not formally part of the multi-state Chesapeake Bay Program, described above, it serves as one element of local government implementation actions to comply with their MS4 Permits and to meet the goals of the Bay Program. Through the HRPDC Chesapeake Bay Committee, which also involves the region's non-permitted communities, staff members responsible for implementation of that program share information on successful program activities. These efforts are closely coordinated with the Regional Stormwater Management Committee. Routinely, the two Committees, meet jointly to address technical and regulatory issues of common concern.

## Water Supply Planning

Beginning with the drought of 2002, the Department of Environmental Quality embarked on an intensive effort to develop regulations governing water supply planning and permitting. This effort was directed by legislation enacted by the Virginia General Assembly in 2003. Through the HRPDC Directors of Utilities Committee, the HRPDC and sixteen localities were heavily involved in these efforts. The HRPDC, as recommended by the Committee, adopted a formal position in support of the water supply planning regulations as finally proposed. These Regulations, governing local and regional water supply planning, became effective in late 2005. The region was also heavily involved in the effort beginning in FY 2003-2004 to develop modifications to the Virginia Water Protection Permit Regulations as they apply to water supply projects. Those regulations became final in early 2006.

Beginning in late Fall 2005, the HRPDC Directors of Utilities Committee began discussions on possible approaches to meeting the planning requirements in a cooperative, regional fashion. With a small grant from DEQ, the HRPDC staff and Utilities Committee have developed a framework for accomplishing development of a regional water supply and educational materials on the state planning requirements. Work continues on the regional water supply plan, with anticipated completion by 2011.

## Water Quality Management Planning

Under the Clean Water Act, state legislation, water quality management planning regulations and a consent order involving the Commonwealth of Virginia and the federal government, the state is proceeding with development of a substantial number of TMDL (Total Maximum Daily Load) Studies and subsequent development of TMDL Implementation Plans. This work follows from the classification of the waters by the state as meeting or failing to meet water quality standards. Water bodies that fail to meet water quality standards are classified as "impaired," triggering the requirement to prepare the TMDL study. Once a TMDL Study is completed, state law requires the development of an Implementation Plan, which will restore water quality in the water body to a level that meets water quality standards.

The HRPDC staff has coordinated regional involvement in the "impaired waters" listing process. This has entailed providing opportunities through the Joint Environmental Committee for education of local government staff on the TMDL process, development of technical comments on the "impaired waters" list and response to the development of TMDLs themselves.

The HRPDC staff is currently working with the region's localities in participating in TMDL studies. To assist the region's localities in addressing this requirement and ensuring that Implementation Plans are consistent with the ability of the localities to implement the recommendations, the HRPDC staff is working with DEQ to devise a cooperative regional partnership to coordinate the TMDL study process with the localities and to develop the required Implementation Plans. This initiative became increasingly important during FY 2009-2010, as TMDLs will have significant impacts on stormwater permits.

Staff worked with DEQ to facilitate local government involvement in the development of seven TMDL studies throughout Hampton Roads. Implementation Plans for bacterial TMDLs for the Back Bay and North Landing watersheds in Virginia Beach were finalized in August 2009. Draft Implementation Plans for bacterial TMDLs for the Upper Nansemond River Watershed in Suffolk and Mill and Powhatan Creek Watershed in James City County were developed in May 2010.

**Sanitary Sewer Overflows**

In late 2004, the HRPDC staff began implementing an electronic reporting and record keeping system known as the Sanitary Sewer Overflow Reporting System (SSORS). This system is considered to be a model and HRPDC staff has provided informational briefings and presentations on this system to a variety of agencies across the state. SSORS enables localities to communicate information about sanitary sewer overflows across departmental lines, allowing for easier reporting. SSORS was the basis for the creation of PARS

Work continues under the Regional Special Order by Consent with DEQ, thirteen local governments, HRSD and HRPDC. The Order established the framework for sewer system evaluation, flow monitoring, determination of allowable levels of infiltration/inflow, system modeling, and the appropriate balance between system and treatment capacity and collection systems.

As a part of this effort, the regional fats, oils and grease abatement program (HR FOG) was invigorated. A variety of materials for restaurants and residents has been developed to inform the public of proper FOG disposal methods. This is relevant to the stormwater program because of the potential for illicit discharges into the stormwater system.

## CONCLUSION

Through the Hampton Roads Planning District Commission, the sixteen localities of Hampton Roads have established a comprehensive Regional Stormwater Management Program. This program provides technical assistance, coordination, comprehensive technical studies and policy analyses and stormwater education, supporting both permitted and non-permitted localities alike. The Regional Stormwater Management Program enables the region's localities to participate actively and effectively in state and federal regulatory matters. It has enhanced the ability of the twelve localities with VPDES Permits for their Municipal Separate Storm Sewer Systems to comply with permit requirements. Their long history of participating in the Regional Stormwater Management Program, enhanced the efforts by the localities that obtained Phase II MS4 Permits in 2003 to move forward cooperatively with permit applications and program development. In fact, their participation in the regional program over the past decade led to the establishment of the cooperative Phase II Permit component of the regional program.

Since the HRPDC staff also coordinates a number of other regional environmental initiatives, the program allows for effective coordination and regional balancing of the various activities. This characteristic of the regional programs facilitated efforts, beginning in FY 2002-2003, by representatives of the RSMC, Directors of Utilities and Hampton Roads Chesapeake Bay Committees and the regional wastewater and solid waste management agencies to address a number of environmental funding and regulatory issues of common interest. On several occasions over the last several years, the HRPDC formally endorsed recommendations developed through this coordinated initiative on state water quality and technology standards, funding guidelines, implementation strategies, as well as on state legislation addressing funding needs for water quality improvement programs.

The Regional Stormwater Management Program provides a mechanism through which the strengths of the sixteen local stormwater programs can be mutually supportive. It allows for cost-effective compliance with permit requirements, resolution of citizen concerns with stormwater drainage and water quality matters, and achievement of improved environmental quality throughout the Hampton Roads Region.

# Exhibit B

## James River and York River Basins
## Urban Runoff Allocations and Percent Reduction

| Constituent | James River Basin (Edge of Stream) 2010 No Action | James River Basin (Edge of Stream) EPA Backstop Allocation | James River Basin (Edge of Stream) Percent Reduction | James River Basin (Edge of Stream) Percent Urban Land Area | York River Basin (Edge of Stream) 2010 No Action | York River Basin (Edge of Stream) EPA Backstop Allocation | York River Basin (Edge of Stream) Percent Reduction | York River Basin (Edge of Stream) Percent Urban Land Area |
|---|---|---|---|---|---|---|---|---|
| Total Nitrogen | 4,157,021 | 2,329,792 | 44.0% | 67.6% | 728,248 | 410,554 | 43.6% | 67.1% |
| Total Phosphosus | 866,239 | 394,401 | 54.5% | 68.5% | 141,304 | 57,879 | 59.0% | 74.2% |
| Total Suspended Solids | 123,376 | 47,048 | 61.9% | 66.8% | 23,167 | 6,194 | 73.3% | 79.1% |

Note: (1) EPA predicts that if E3 was applied to 100% of urban areas, the percent reductions for TN, TP and TSS would average about 65%, 80% and 93%, respectively, for the York River and James River Basins. The percent urban land area served by BMPs is based on dividing the EPA Backstop Allocation percent reduction by the E3 percent reduction. For example, the Percent Urban Land Area for James TP = 54.5% / 80% = 68.5%, which means 68.5% of the urban land area would require a BMP to reach the 54.5% percent reduction necessary to meet the WLA (assuming there was no urban nutrient management).

# Exhibit C

## Estimated Capital Costs, Average Stormwater Bills and Statistics for Hampton Roads Communities

| Category | Row | Item | TMDL 50% Retrofit Assumption on Regulated Stormwater | | Reductions to Meet TMDL WLA |
|---|---|---|---|---|---|
| | | | Scenario 1a: All BMPs ($/yr) | Scenario 2a: Fewer BMPs & Storage ($/yr) | Scenario 2b:[1] Fewer BMPs & Storage ($/yr) |
| Estimated Costs | A | Estimated Capital Cost (Millions) | $3,772 | $6,235 | $9,792 |
| | B | Estimated Annual Cost (Millions per year) | $405 | $669 | $1,050 |
| Estimated Average Annual Stormwater Bills | C | Residential House ($/yr) | $510 | $850 | $1,300 |
| | D | Convenience Store/ Gas Station ($/yr) | $4,600 | $7,500 | $12,800 |
| | E | Neighborhood Shopping Center ($/yr) | $30,800 | $50,000 | $85,500 |
| | F | Church ($/yr) | $10,300 | $16,700 | $28,500 |
| | G | Regional Mall ($/yr) | $465,000 | $756,000 | $1,292,000 |
| Census Households & Population | H | 2009 Household Estimate | 630,776 | 630,776 | 630,776 |
| | I | 2009 Population Estimate | 1,641,298 | 1,641,298 | 1,641,298 |
| | J | Total Annual Fee Per Household[2] ($/yr) (Row "B" / Row "H") | $640 | $1,060 | $1,670 |
| | K | Total Annual Fee Per Person[2] ($/yr) (Row "B" / Row "I") | $250 | $410 | $640 |
| Financial Burden | L | 2009 Medium Household Income Estimate | $55,404 | $55,404 | $55,404 |
| | M | Residential House Stormwater Fee as Percentage of MHI (Row "C" / Row "L") | 0.9% | 1.5% | 2.3% |
| | N | Total Household Stormwater Fee[2] as Percentage of MHI (Row "J" / Row "L") | 1.2% | 1.9% | 3.0% |

Note: (1) Does not include performance of urban nutrient management
(2) Simulates stormwater costs passed on to consumer by retail stores, gas stations, etc.

# Exhibit D

## Summary of Impervious Area

| Locality | EPA Total Land (acres) | EPA Impervious Land (acres) | Local Estimate Impervious Land (acres) | Percent difference from EPA to Local Impervious Estimate |
|---|---|---|---|---|
| Hampton | 32,552 | 6,625 | 10,198 | 54% |
| Newport News | 42,903 | 8,624 | 10,926 | 27% |
| | | | | |
| Isle of Wight | 100,747 | 1,318 | 1,360 | 3% |
| James City | 90,603 | 3,039 | 7,028 | 131% |
| York | 66,981 | 3,392 | 4,022 | 19% |
| Poquoson | 9,238 | 430 | 663 | 54% |
| Suffolk | 100,572 | 3,758 | 5,307 | 41% |
| Williamsburg | 5,496 | 625 | 985 | 58% |

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August 16, 2010

**By Email & U.S. Mail**

Robert Koroncai
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103

**Re: James River Site-Specific Chlorophyll-*a* Criteria**

Dear Mr. Koroncai:

Following up on our conversation at the recent EPA Region III Municipal Water Quality Meeting in Washington, D.C., I am writing to provide the attached summary of VAMWA's perspectives and recommendations on the James River Site-Specific Numeric Chlorophyll-*a* Criteria and associated wasteload allocations.

A core recommendation is that the Chesapeake Bay and/or James River TMDL process accommodate a review and appropriate revision of these unique criteria to improve the currently weak linkage between the criteria and designated use attainment. As you know, aside from the higher D.C. criteria, the Virginia/James River criteria are the only numeric chlorophyll-a criteria for Bay tidal waters, and these were adopted essentially on a first-ever or experimental basis in 2005 despite significant remaining scientific questions. Furthermore, significant new information is available at this time that is not reflected in the existing criteria.

The attached information, which was prepared by VAMWA's technical team, demonstrates the requested review and update is both a practical and necessary step prior to TMDL-based additional regulation beyond the Tributary Strategy level.

Sincerely,

Christopher D. Pomeroy
General Counsel

Enclosure

Copy to:
Mr. Alan Pollock, DEQ
VAMWA Board

# CHLOROPHYLL-A STANDARDS & IMPLEMENTATION
# AUGUST 16, 2010

VAMWA has been active on the chlorophyll-*a* topic since USEPA's initial efforts to derive Baywide criteria in 2000. Over this time, VAMWA representatives have served on technical committees, contributed independent data analyses, and provided numerous sets of technical comments on chlorophyll-*a*. In the interest of being concise, the main body of this letter summarizes and references much of this previous work. The summary is organized into the following categories:

I. A brief history of the James River chlorophyll-*a* criteria
II. Opportunities to improve the chlorophyll-*a* criteria
III. Perspectives on the current TMDL process and draft wasteload allocations
IV. Summary of recommendations

## I. A BRIEF HISTORY OF THE JAMES RIVER CHLOROPHYLL-*A* CRITERIA

The technical work underlying the existing James River chlorophyll-*a* standards dates to various USEPA and DEQ efforts in the 2000-2005 timeframe. Following is a summary of these efforts, which is included to provide the necessary perspective on the situation Virginia faces today.

### A. 2000-2003—USEPA-Led Efforts

Upon the adoption of the Chesapeake 2000 agreement June 2000, USEPA announced its intention to refine or derive Baywide criteria for dissolved oxygen (DO), water clarity, and chlorophyll-*a*, and formed scientific task groups for each criterion. Representatives from VAMWA served on all three task groups. The subsequent technical work over 2000-2003 revealed that, while all three criteria were technically challenging, the chlorophyll-*a* criterion was by far the most difficult to relate to designated use attainment in a manner that was not simply redundant of DO and water clarity criteria.

The first draft of the document (July 2001) emphasized the "Phytoplankton Reference Community Approach" along with other secondary sources of information such as historical values, literature values, and contributions to light attenuation and low DO. After the first review period, it was recognized that these lines of evidence lacked sufficient linkages between chlorophyll-*a* and designated uses (VAMWA & MAMWA, 2001).

A second draft (May 2002) emphasized "food quality" connections and mesoplankton abundance. VAMWA supported exploration of this approach, and contributed independent data analyses. However, rigorous reviews of this approach revealed that chlorophyll-*a* was not a useful indicator of adverse impacts to food quality or mesoplankton abundance (VAMWA & MAMWA, 2002). The draft criteria document received an adverse review by the Scientific and Technical Advisory Committee (STAC, 2002), and the "food quality" discussion was removed as a primary line of evidence. Similarly, linkages of chlorophyll-*a* to harmful algal blooms (HABs) were attempted, but there was insufficient data/information at that time to derive widely-applicable criteria (VAMWA & MAMWA, 2003).

Ultimately, USEPA recognized these deficiencies and made the correct decision not to publish Baywide chlorophyll-*a* criteria as part of the 2003 criteria document (USEPA, 2003). What *was* published represented a compilation of the multiple lines of inquiry from the 2000-2002 timeframe, a related table with a wide range of chlorophyll-*a* values, and an encouragement for states to use this information in developing site-specific chlorophyll-*a* where needed. In our review of this document (VAMWA & MAMWA, 2003), VAMWA expressed concern that the technical problems of using these values as criteria might not be fully recognized by the document's intended audience, and recommended specific language to prevent this outcome.

**B. 2003-2005—Derivation of James River Chlorophyll-a Criteria**

Due to the James River's relatively healthy DO levels, lack of significant influence on mainstem Bay DO, and solids-dominated clarity issues, it was recognized that neither DO nor water clarity criteria were likely to justify stringent nutrient controls in the James River estuary. In 2003, the Virginia DEQ initiated a rulemaking to make chlorophyll-*a* criteria the primary driver of nutrient controls in the James River.

In attempting to derive James River chlorophyll-*a* criteria in 2003-2004, the Virginia DEQ relied on the limited information available at the time. The technical basis for the criteria published in November 2004 relied on heavily on lines of support drawn from the USEPA's 2003 criteria document. The technical support document (Virginia DEQ, 2004) emphasized concerns over high chlorophyll-*a* and cyanophyte levels in the tidal fresh segments, and trends in potential bloom-forming phytoplankton taxa in the lower estuary. The proposed chlorophyll-*a* values represented a professional judgment of seasonal mean conditions representing a balanced phytoplankton population, and were also influenced by expectations of attainability under expected nutrient control scenarios.

VAMWA was highly involved at all stages of the public participation process for the James River chlorophyll-*a* criteria. Due to our familiarity with the scientific shortcomings of the 2001-2003 efforts, we initially recommended that Virginia adopt an adaptive management approach that used monitoring and research to strengthen the understanding of relations between chlorophyll-*a* and harmful algal blooms (VAMWA, 2004). When this course was not followed, we commented extensively on the subsequent criteria proposals (VAMWA 2005a, 2005b). In general, we concluded that the proposed criteria were highly subjective, lacked scientific linkages to unfavorable algal/ecological conditions, were strongly influenced by a pre-determined load allocations, and could result in huge expenditures with few tangible benefits. Our comments were supported by independent literature reviews and data analysis.

In 2005, the Virginia DEQ (with USEPA's assistance) performed the *James River Alternatives Analysis* (DEQ, 2005) in response to stakeholder concerns over the subjectivity, cost, and attainability of the proposed criteria. The purpose of this modeling analysis was to determine if "different cap load allocations could achieve equivalent environmental benefits with much lower economic impacts". The results were used not only to adjust the cap allocations, but also to adjust the proposed chlorophyll-*a* criteria in certain segment seasons. Hence, the criteria adopted in 2005 were inherently linked to expectations of attainment under a specific management scenario and the Phase 4.3 modeling framework.

### C. 2008-2010—New Model, Different Answer

Under the present Phase 5 modeling framework used for the 2010 TMDL, the James River chlorophyll-*a* criteria are no longer predicted to be attainable at the previously-established loading level. This has put Virginia in the situation of possibly incurring an *additional* $1.5 to 2.0 billion in nutrient implementation costs to meet a scientifically problematic, first-of-its-kind standard that was itself partially based on the assurance of attainability under a different modeling framework.

Section III of this letter summarizes VAWMA's serious concerns with the 2008-2010 TMDL allocation process for the James River. However, we would first like to take the opportunity (in section II) to explain why we believe that the James River chlorophyll-*a* standards can be markedly improved from a scientific and ecological basis, relying on data and research not available in 2000-2005.

## II. Opportunities to Improve the Chlorophyll-*a* Standard & modeling framework

In VAMWA's view, several important new sources of information and data provide the opportunity to reevaluate and improve the basis of nutrient controls in the James River basin. These include academic research, USEPA research, and DATAFLOW monitoring results for the both the upper and lower James River. It would be premature to proscribe the specific methods or results of such as reevaluation. However, in the interest of showing the real promise of such an effort, we present here some specific examples of how linkages could be improved.

In VAMWA's view, modest year-to-year variations in the seasonal mean chlorophyll-*a* probably have very little to with aquatic life use attainment. One potential basis for improved an improved nutrient control framework would be linkages between chlorophyll-*a*, harmful algal blooms (HABs), and/or HAB toxins. Potential HAB taxa occur in both the low salinity and high salinity segments of the James River estuary. Although research available in 2003-2005 began to make some of these linkages, we believe that data and research since 2005 provide the opportunity to greatly improve the James River chlorophyll-*a* criteria.

### A. Low Salinity Segments

In the 2004-2005 timeframe, VAMWA advocated the exploration of chlorophyll-*a* criteria in low salinity segments based on segment-specific empirical relations with potential HAB taxa such as *Microcystis aeruginosa*, which is a common inhabitant of the tidal freshwater James River. Certain strains of *M. aeruginosa* produce a toxin called microcystin that can be harmful to humans and aquatic life (Lampert, 1981; Fulton and Paerl, 1987; Fulton and Paerl, 1988), and *M. aeruginosa* has been known to cause nuisance blooms in other systems such as the Potomac River. It is not known if the James River strains are toxin-producing, and in general the James River does not experience the types of nuisance bloom conditions that have sometimes occurred on the Potomac River. However, previous work by VAMWA has explored the relations between chlorophyll-*a*, total cyanophytes, *M. aeruginosa*, and mesozooplankton abundance. Relatively strong empirical relations were evident.

Two years after the adoption of the James River chlorophyll-a criteria the USEPA published the *2007 Chlorophyll Criteria Addendum* (USEPA, 2007). This document provided the basis for chlorophyll-*a* criteria based on linkages with *M. aeruginosa*. VAMWA considered portions of this document as a step forward in linking chlorophyll-*a* criteria to designated use attainment. A strength of USEPA's approach was the joint consideration of the chlorophyll-*a*, *M. aeruginosa* cell count, and microcystin concentration.

We believe this approach merits consideration for application to the tidal freshwater James River. Relations between chlorophyll-*a* and *M. aeruginosa* can vary widely between segments, and so it would recommended to closely explore the James-specific relations. The *2007 Chlorophyll Criteria Addendum* relied heavily on data from the Potomac River and upper Chesapeake Bay tributaries, and derived a threshold chlorophyll-*a* concentration of 27.5 ug/L. In contrast, the appropriate threshold for the James River is probably in the 36-40 ug/L range (Figure 1). It is also recommended to conduct monitoring to determine whether the James River strains of *M. aeruginosa* produce microcystin, and if so, at what concentrations.

It is not known if a HAB-based criterion for the low salinity segments of the James River would be more or less stringent than the existing criteria. The criteria magnitude would likely rise, but changes in the frequency/duration components could cause the criterion to become more stringent. In addition, it must be considered that cyanophytes such as *M. aeruginosa* are natural components of the phytoplankton assemblage in this segment, and thus attainability should also factor in to the overall assessment. Attainability is especially important to consider for the region near the confluence of the James River with the Appomattox River, where river morphology and hydraulics cause a natural chlorophyll-*a* peak. Nevertheless, VAMWA strongly recommends consideration of the HAB-related lines of evidence, among other potential approaches for refining the James River nutrient control framework.

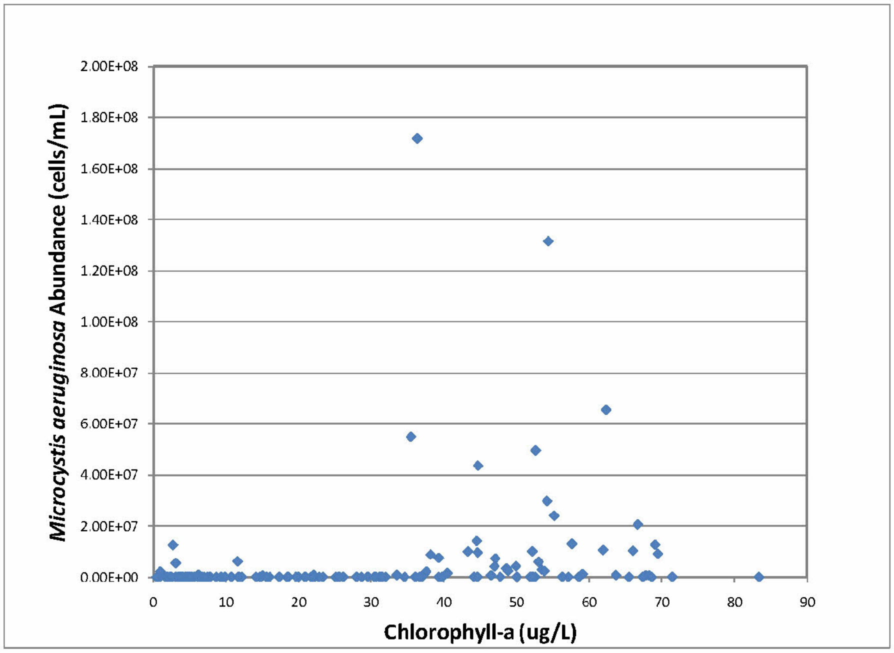


**Figure 1**—Scatterplot of *M. aeruginosa* abundance versus chlorophyll-a at station TF5.5 in the James River estuary, 1986—2006. Data courtesy of R. Lacouture.

## B. Higher Salinity Segments (Lower James River)

As in the upper estuary, HAB linkages merit exploration as one potential basis for revision of the nutrient control framework in the lower James River estuary. During the final comment period on the standards, VAMWA recommended an anti-degradation and adaptive management approach be taken on the lower James River as a precaution against HABs. This recommendation reflected our belief that the HAB related end-point probably offered the best approach to developing a defensible standard among the many others that were considered. Addressing HABs is important because they can result in direct effects on designated uses such as fish, oysters, user perceptions, etc.

There is now considerably more data and information available to make connection between chlorophyll-*a* and HABs than was previously available. HRSD began weekly water quality monitoring in the lower James River in 2005 that is presently on-going. The main objective of the program is to collect data sufficient to assess the chlorophyll and water clarity standards according the EPA guidance (EPA 2003) for monitoring bay related standards. HRSD, VADEQ, and VIMS collectively established procedures to ensure quality control and incorporate the data in the regulatory assessments of the standards. The monitoring program utilizes the DATAFLOW system developed by VIMS for the purposes of chlorophyll *a* and water clarity criteria assessment (Moore and others 2003). Since its inception there have been over 350 cruise dates successfully conducted in the Hampton Roads. As a result, over 1.2 million chlorophyll-*a* and related water quality observations are available. This information along with continuous monitoring site data collected by VIMS is made publically available through the Virginia Estuarine and Coastal Observing System (VECOS) (http://www2.vims.edu/vecos/). This information would be valuable to a standards revision because it serves to assess the dynamics of algal blooms with a high level of spatial and temporal resolution.

During 2008 Old Dominion University (ODU) began using VECOS data to expand its research into the environmental triggers and dynamics of HABs in the Hampton Roads. The products of this research resulted in a number of scientific papers related to *Cochlodinium polykrikoides* blooms (Mulholland and others, 2009; Morse and others, 2009; and Morse and others, 2010) These studies indicated that C*ochlodinium polykrikoides* blooms in 2007 and 2008 coincided with periods of intense summer rains and storm water runoff following droughts. Initiation of algal blooms was also found to be correlated with neap tides, vertical stratification of the water column, and low wind conditions. Similar patterns have been observed in 2009 and 2010 since the scientific papers were written. Another major finding was that the Lafayette and Elizabeth Rivers appear to act as an initiation grounds for *Cochlodinium polykrikoides* blooms. Through use of the VIMS model the authors demonstrated that that the bloom organism was transported from the Lafayette and Elizabeth Rivers into the lower James River where it later became fully established.

The above research results are directly applicable to chlorophyll management of the James River. We believe that key elements to reducing chlorophyll a levels in the James River in the future should include (a) greater measures to reduce nutrient pulses due to storm water inputs and (b) placing more attention to the inter-connected nature of the Lafayette and Elizabeth River systems with respect to James. The present TMDL and associated modeling does not capture these key elements and smaller scale effects.

Based on the greater information now available. the following specific concepts should be considered among other opportunities for revision of the nutrient control framework for the lower James River.

1. Nutrient control framework revision

- Revise the standard to address *Cochlodinium polykrikoides* blooms as the indicator HAB. Although other HAB phytoplankton species are also of concern (particularly toxin formers), *Cochlodinium polykrikoides* appears to be the best studied, obvious, and problematic for Hampton Roads. Annual summer blooms of this species have become a predictable and routine occurrence. Blooms of this species are primarily responsible for the non-attainment status of the existing chlorophyll standard during the summer. Because of the extreme influence of bloom events on ambient chlorophyll*a* conditions it is essential that the standard and modeling system be revised to effectively address them. Note: *Heterocapsa triquetra* appears to be responsible for algal blooms in the JMSMH segment during the spring season and should be considered during a standards revision as well for the spring season. However, the data related to this species is presently more limited.

- Refine relationships between algal cell counts and impacts on designated uses. Some data is presently available in the literature but additional studies are needed to determine cause and effect relationships between cell counts and various biological end-points for the specific area.

- Refine relationships between algal cell counts and chlorophyll-*a*. Recent data (Figure 2) indicates a regression relationship exists between *Cochlodinium polykrikoides* cell counts and chlorophyll a. A continued refinement of this relationship could provide a direct connection between chlorophyll a concentration and impairment of designated uses (i.e. through the relationship with cell counts).

- Determine acceptable limits on the size and duration of algal blooms. Isolated bloom patches and/or those which are short-lived may not cause significant ecological damage in a large system such as the James. However, when these blooms become expansive and/or long-lived the environmental consequences can be more serious. Part of the proposed standard revision should consider establishing appropriate limits at these scales. Once established these limits could become the basis for biological reference curves needed for criteria assessment. The existing chlorophyll standards utilize a default 10% reference curve that is unrelated to designated use impairment.

2. <u>Chlorophyll-*a* modeling improvements</u>

Our recent comments on the chlorophyll-*a* modeling indicated concerns about the reliability of the results relative to the precision with which they were expressed. To address those concerns we recommend that the chlorophyll-*a* modeling be significantly improved. It is essential that the TMDL model reasonably simulate bloom dynamics and the controlling processes at scales upon which they occur. However, the existing model was designed to simulate long term averages in chlorophyll and estimate the effects of nutrient reduction on chlorophyll-*a* as step trends. Such a simplistic modeling approach cannot assess the effects of nutrient reduction on short-term bloom events, which represent the true environmental problem – and the present cause for standards non-attainment. As a result, we have very little confidence that the James River will actually respond to nutrient reduction in the manner in which it is now projected. High density chlorophyll-*a* data that is now available in the lower James River would greatly assist in the development and calibration of models relative to such bloom events.

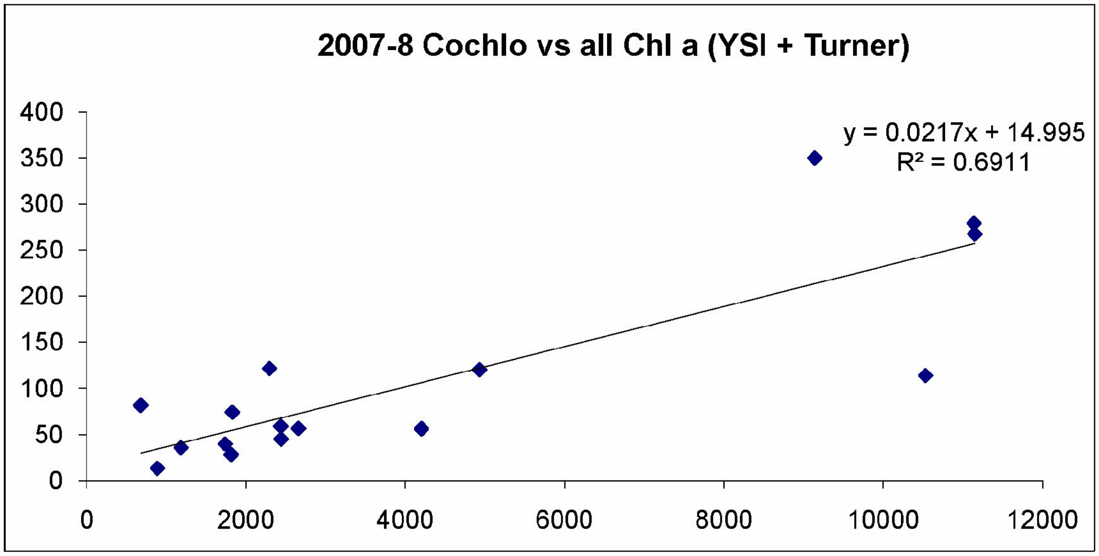


**Figure 2**—Relationship between Cochlodinium cell counts (x-axis- #/ml) vs chlorophyll a (ug/l). Figure and data provided courtesy of Ryan Morse, Old Dominion University.

In addition, we support EPA's efforts to consider the role of Atlantic menhaden in relation to management of chlorophyll-*a*. Recent modeling work has shown that their migration into the tributaries and associated consumption of algae has the potential to affect chlorophyll-*a* and associated compliance with the standards. Although present menhaden stocks do not appear to dramatically reduce chlorophyll-*a* (as long term averages) incremental effects due to increasing the size of the stock are considered comparable to nutrient reduction. We recommend that additional analyses be conducted to evaluate the effect of increasing menhaden stocks on seasonal peaks and/or worst years in the record. Further, additional modeling enhancements should be made such that the menhaden migration and residence time varies according to a food gradient. A number of papers indicate that menhaden consumption of algae increases in areas with higher chlorophyll-*a*. This is logical since the species would remain longer in an area with greater availability of food. Because the model does not presently capture these foraging effects the available reductions in chlorophyll due to menhaden (especially during bloom conditions) could be under-estimated.

In summary, effective management of the nutrient control framework in the lower James River requires a revision of both the standard and modeling framework.

## III. Perspectives on the Current TMDL Process and Draft Wasteload Allocations

The outcome of the 2008-2010 TMDL process resulted in large (15-30%) reductions in the James River basin's nutrient allocations, estimated to cost an additional $1.5 to 2.0 billion in capital implementation costs above the already-costly tributary strategy level of effort (VAMWA, 2010a). In VAMWA's view, these large cuts and increased expenditures are unjustified both on technical and policy grounds. Major problems include: (1) the failure to resolve problems with the James River chlorophyll-*a* criteria; (2) a problematic, non-transparent modeling framework; and (3) lack of water quality benefits. These problems were discussed in a prior technical memo (VAMWA 2010b—Attachment A) and summarized below.

## A. Failure to Resolve Problems with James River Chlorophyll-*a* Criteria

As outlined in section I of this letter, the James River chlorophyll-*a* criteria represented a difficult, highly subjective, first-of-its kind regulation. Linkages to ecology are weak at best, and the criterion was directly based (in part) on model predictions of attainability. It is unacceptable that criteria and allocations should be based on one model prediction, and then huge allocation cuts promoted based on another modeling framework, without revisiting the criterion itself. Such an approach would ignore the history and uncertain nature of the standard. More importantly, it would fail to take advantage of the opportunity to improve the scientific/ecological basis of the standard.

## B. Problematic, Non-Transparent Modeling Framework

Since December 2009, VAMWA has raised questions on the James River chlorophyll-*a* modeling calibration and utility (Bell, elec. comm., 4 Jan. 2010). These include

- Obviously erroneous calibration in certain segment-seasons (JMSTFL, JMSPH).
- Model post-processing problems as evidenced by problematic regressions used to scenario-transform the data.
- Unexplained model anomalies
- High leverage of few data in the data transformation process (e.g., September 1999 data at LE5.2).

Although these issues have been recognized for certain segment-seasons in which there were most obvious, we see no indication that the CBP has performed a more systematic review of the same issues in all segment-seasons, determined the causes/extent of model anomalies, or fully evaluated the predictive capabilities of the model. We see no evidence that USEPA has performed a systematic examination of whether the model correctly predicts the magnitude and direction of inter-annual changes in chlorophyll-*a*, nor an examination of whether the same problems that cause counterintuitive results in some segment-seasons might also be more causing more systematic, less obvious problems in other segment-seasons.

Under the current approach, management decisions are highly susceptible to the criticism that CBP has been highly selective and partially arbitrary regarding which model predictions are usable and which are not. We have recommended that the CBP develop a set of objective criteria for evaluating model behavior that includes: (1) a systematic evaluation of the ability of the model to quantify changes in chlorophyll-*a*; and (2) an evaluation of the causes of problem model chlorophyll-*a* predictions, and how those causes might affect the model accuracy/precision on a model global level (VAMWA, 2010b—Attachment A)

## B. Lack of Water Quality Benefits

USEPA justification for going beyond the 190/13 allocation level appears to be 2-3% reductions in non-attainment in selected segment seasons, corresponding to 1-2 ug/L reduction in chlorophyll-*a* in selected segment seasons (VAMWA, 2010b—Attachment A). It is a misapplication of the model framework to claim that it is capable of distinguishing between model scenarios at these levels, or that huge implementation/cost escalations should be made based on these tiny predicted shifts.

If the model cannot distinguish between D.O. non-attainment rates of 0% and 1% (as acknowledged by USEPA), the spread in distinguishable non-attainment rates for chlorophyll-*a* can be expected to be greater. VAMWA has performed analyses to demonstrate that the tiny predicted shifts in chlorophyll-*a* are smaller than the field/laboratory error and smaller than could be detected in long-term monitoring data (VAMWA, 2010b—Attachment A). The post-processing regression equations for the key scenarios in question might not even be significantly different. Although VAMWA does not have yet access to the regression data, is appears likely that statistical hypothesis testing would indicate that the parameters of these regressions might not even be statistically distinguishable. Given the strong implicit margin of safety of the Bay TMDL, VAMWA believes it is acceptable to base allocations on "essentially equivalent" model scenarios, with the choice of scenario informed by a strong understanding of the precision of the underlying criteria, model predictions, monitoring capabilities, and cost-benefits.

## IV. SUMMARY OF RECOMMENDATIONS

Based on the technical comments and perspectives present in this letter, VAMWA's recommendations are as follows:

A. Set the James River basin's 2010 TMDL allocations at tributary strategy levels.

B. In the TMDL/WIP process, include opportunity for a comprehensive reevaluation of the James River chlorophyll-*a* criteria and modeling framework, to be completed by 2017. This time period also provides an excellent opportunity to assess the influence of tributary strategy implementation progress on the dynamics of existing algal blooms on the James River. A number of point source projects are scheduled to be completed by January 2011. Continued application of the DATAFLOW program over time offers a means to assess and quantify changes in HABs and chlorophyll levels relative to implemented nutrient controls during this time period.

C. Review the James River TMDL allocations in 2017 based on the outcome of the criteria review.

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# ATTACHMENT A

## June 30, 2010 Review of USEPA James River Chlorophyll-*a* Recommendations and Supporting Materials.

MALCOLM PIRNIE

# Technical Memorandum

Date: June 30, 2010

To: Virginia Association of Municipal Wastewater Agencies

From: Clifton F. Bell, Malcolm Pirnie, Inc.
Will Hunley, Hampton Roads Sanitation District

Re: Review of USEPA James River Chlorophyll-*a* Recommendations and Supporting Materials

The following technical comments are related to materials contained in the USEPA Chesapeake Bay Program's (CBP) presentation entitled "Achieving Attainment of the James Chlorophyll Water Quality Standard", dated June 18, 2010. In this presentation, EPA concludes that nutrient loadings of 23.5 TN/2.34 TP were estimated to achieve the James River chlorophyll-*a* standards. If these specified loadings were chosen as basin allocations they would result in a reduction of 4.6 TN/1.31 TP relative to the presently established tributary strategy loads of 28.1 TN/3.65 TP. However, the available technical information does not adequately support or justify nutrient reductions beyond the existing tributary strategy level for the following reasons:

- The James River chlorophyll-*a* modeling framework continues to have major technical problems including poor calibration and unexplained anomalies.
- The CBP has only partially recognized/addressed modeling problems, and has lacked clear criteria for evaluating the model accuracy, precision, and utility. The result has been a semi-arbitrary selection of which model results/data to use for load allocation or which model results to ignore.
- The predicted changes in chlorophyll-*a* (on the order of 1-2 ug/l seasonal average and 2-4% in terms of non-attainment rates) are smaller than those than can be precisely distinguished by the model, detected in monitoring data, or concluded to have ecological significance.
- Relatedly, the predicted response of chlorophyll-*a* to nutrient load reductions are extremely "flat" in key segment-seasons. Such a misapplication of the modeling framework could lead to huge expenditures without significant changes in standards attainment or result in tangible environmental improvement.

Specific comments are provided below:

1. *The James River chlorophyll-a modeling framework has major calibration/behavior problems that have only been partially recognized and addressed*: Since December 2009, VAMWA has raised questions on the James River chlorophyll-*a* modeling calibration and utility (Bell, elec. comm., 4 Jan. 2010). Although the CBP has not specifically responded to the VAMWA's request for a detailed examination of model calibration

problem, a review of the June 18, 2010 materials indicates that the CBP has recognized certain model calibration and post-processing issues, including the following:

- Obviously erroneous calibration in certain segment-seasons (JMSTFL, JMSPH).
- Model post-processing problems as evidenced by problematic regressions used to scenario-transform the data.
- Unexplained model anomalies
- High leverage of few data in the data transformation process (e.g., September 1999 data at LE5.2).

Although these issues have been recognized for certain segment-seasons in which there were most obvious, we see no indication that the CBP has performed a more systematic review of the same issues in all segment-seasons, determined the causes/extent of model anomalies, or fully evaluated the predictive capabilities of the model. The main criteria that CBP appears to have used to deem model results as acceptable for a given segment-season appear to be:

- Whether or not the model predicts the approximate range of chlorophyll-*a*, without a systematic examination of whether the model correctly predicts the magnitude and direction of interannual *changes* in chlorophyll-*a*.
- Whether or not the model predicts decreasing chlorophyll-*a* with decreasing nutrient loads, without an examination of whether the same problems that cause counterintuitive results in some segment-seasons might also be more causing more systematic, less obvious problems in other segment-seasons.

Under the current approach, management decisions are highly susceptible to the criticism that CBP has been highly selective and partially arbitrary regarding which model predictions are usable and which are not. It would be recommended that the CBP develop a set of objective criteria for evaluating model behavior that includes: (1) a systematic evaluation of the ability of the model to quantify changes in chlorophyll-*a*; and (2) an evaluation of the causes of problem model chlorophyll-*a* predictions, and how those causes might affect the model accuracy/precision on a model global level.

2. *The predicted changes in chlorophyll-*a *are smaller than can be precisely quantified by the model*. Based on a review of the June 18, 2010 materials, CBP's justification for going beyond the 190/13 allocation level appears to be very small decreases in chlorophyll-*a* and non-attainment rates:

- 2-3% reductions in non-attainment in selected segment seasons (JMSTFL, JMSMH)
- 1-2 ug/L reduction in chlorophyll-*a* in selected segment seasons. (see Attachment A)

It is a misapplication of the model framework to claim that it is capable of distinguishing between model scenarios at these levels, or that major management decisions should be made based on these tiny predicted shifts. The precision of chlorophyll-*a* predictions can be expected to be significantly less than that for mainstem Bay dissolved oxygen (D.O.), which enjoys a much better calibration. If the model cannot distinguish between D.O. non-attainment rates of 0% and 1% (as acknowledged by CBP), the spread in distinguishable non-attainment rates for chlorophyll-*a* can be expected to be greater. Given the strong implicit margin of safety of the Bay TMDL, it cannot be concluded that model is precise enough to distinguish between scenarios that predict 0-1% nonattainment and 2-4% nonattainment.

The post-processing regression equations for the key scenarios in question might not even be significantly different. Examining the chart on the lower right of slide 12, is appears that the offset in regression equations for multiple scenarios is significantly less than the spread of data around the regression lines. (It is recommended to zoom in on the slide to visually examine the three scenario lines between the calibration and E3 scenarios). Although VAMWA did not have access to the regression data, is appears likely that statistical hypothesis testing would indicate that the parameters of these regressions are within each other's 95% confidence limits, and they are probably not even statistically distinguishable.

3. *The predicted changes in chlorophyll-*a *are smaller than could be detected in monitoring data*. It can demonstrated that tiny predicted shifts in chlorophyll-a between the 190 scenario and the "between 170/Potomac" scenario would not even be detectable in light of environmental, sampling, and analytical variability. For example:

(a) Power analysis demonstrates that even after long (25 year) monitoring periods, the minimum significant difference (MSD) in seasonal mean chlorophyll-a would be in the 2-4 ug/L range for most attaining segment seasons (Attachment B). Thus, it appears that the modeled shift in chlorophyll-*a* between the 190 and the "between 170/Potomac" scenario would probably not be detectable in the monitoring data.

(b) Based on a review of laboratory split sample results for the 1991-2000 James River data obtained from the CBMP data hub, the median relative percent difference (RPD) in chlorophyll-*a* samples was about 16 percent, corresponding to 1-4 ug/L chlorophyll-*a*, depending on segment and season (Attachment C). Thus, analytical variability alone is equal to or greater than the modeled shifts in chlorophyll-*a* between the 190 scenario and the "between 170/Potomac" scenario. Consideration of field (sampling) variability would the total variance of chlorophyll-*a* measurements to increase even further.

4. *The predicted changes in chlorophyll-*a *are not ecologically significant*. The difference in chlorophyll-*a* levels predicted between tributary strategy and the proposed reduced allocation scenarios (on the order of 1-2 ug/l seasonal average and 2-4% in terms of non-attainment rates) are exceptionally small in magnitude. This estimated level of change is too small to be seriously considered a matter of practical importance or consequence to Bay restoration. Even if the model could adequately discern such differences (which we dispute as discussed above) they would probably not result in tangible environmental

benefits. It should be remembered that the chlorophyll-*a* standard development process was acknowledged by VDEQ and stakeholders to be highly imprecise. Although its precision could not be quantified, revisions made to the criteria values on the basis of attainability were well within the differences described above. This shows that environmental conditions are essentially equivalent at the scale of a few micrograms.

VAMWA has consistently recommended that the James River chlorophyll-*a* standards eventually undergo reevaluation to take advantage of more recent monitoring data and research. It would be inappropriate to slash load allocations unless such a process clear demonstrated the ecological need.

5. *The predicted response of chlorophyll-a to nutrient load reductions are extremely "flat" in key segment-seasons*. This means that very large reductions in nutrient loading would result in only very small incremental reductions in chlorophyll-*a* concentrations and/or reductions in non-attainment rate. For example the critical segments of the tidal freshwater and lower estuary are predicted to have response rates of approximately 0.4 and 0.2 ug/l chlorophyll response per Mlb/yr TN reduction. Such a misapplication of the modeling framework could lead to huge expenditures without significant changes in standards attainment or result in tangible environmental improvement.

In previous Bay TMDL comments HRSD estimated nutrient control capital costs at $150M per mpy TN reduction. Clearly, such a misapplication of the modeling framework could lead to huge expenditures without significant changes in standards attainment or result in tangible environmental improvement.

## CONCLUSIONS

Although we recognize the tight schedule for the Baywide TMDL, we do not believe it is the best interests of Virginia or the environment to make large cuts to allocations on the basis of near non-detectable shifts in chlorophyll-*a* predicted by a problematic, imprecise model. It is recommended that TMDL allocations for the James River be based on the 191/14.4 (Tributary Strategy) scenario, and that Virginia initiate a longer-term process for reevaluating and refining the modeling framework, chlorophyll-*a* standards, and load allocations as necessary.

## ATTACHMENT A
## Estimation of the Magnitude of Model-Predicted Changes in Chlorophyll-*a*

This attachment describes how the CBP presentation entitled "Achieving Attainment of the James Chlorophyll Water Quality Standard" (dated June 18, 2010) was used to interpret the magnitude of predicted changes in seasonal average chlorophyll-*a* between the 190/12.7 scenario and the "between 170/Potomac" scenario. VAMWA did not have access direct access to model output or post-processing regression equations for most segments and months. Therefore, the approximate magnitude of the shift was estimated by examination of regression relationships for key segment-months:

- JMSTFL April 1995 (slide 6), taken as representative of JMSTF Spring
- JMSMH September 1999 (slide 12), taken as representative of JMSTF Summer

The offsets in predicted ln_chla between regression lines for different scenarios were quantified as a function of decreases in the James River total nitrogen load. These demonstrated an approximately linear relation between ln_chla and TN load, with the following approximate slopes:

- JMSTFL Spring: 5.72E-2 reduction in ln_chla for every 1 Mlb/yr TN reduction in the James River TN load.
- JMSMH Summer: 3.37E-2 reduction in ln_chla for every 1 Mlb/yr TN reduction in the James River TN load

The "between 170/Potomac" scenario represents a 3.1 Mlb/yr reduction in James River TN load, relative to the 190 scenario. This corresponds to the following predicted reductions in ln_chla:

- JMSTFL Spring: 0.177 reduction in ln_chla.
- JMSMH Summer: 0.104 reduction in ln_chla

As these JMSTF-Spring and JMSMH-Summer approach attainment with the existing chlorophyll-*a* criteria, their seasonal average chlorophyll-a values will approach 15 ug/L and 10 ug/L, respectively. At these levels, the predicted reduction in ln-chla listed above would correspond to the following reductions in chlorophyll-a concentration:

- JMSTFL Spring: ~2 ug/L reduction in chlorophyll-*a*
- JMSMH Summer: ~1 ug/L reduction in chlorophyll-*a*

## ATTACHMENT B
## Power Analysis of Seasonal Mean Chlorophyll-*a*

A two-sample power analysis was conducted to determine the minimum significant difference (MSD) in the seasonal mean chlorophyll-*a* concentrations that could be expected in the James River, Virginia. Values of $\alpha$ and $\beta$ were set to conventional values of 0.05 and 0.2, respectively. The value of n was selected as 25, representing the approximate number of years for which a pre-TMDL seasonal mean could be calculated for most James River segments, and also representing a 25-year post-TMDL monitoring period.

In order to determine the standard deviation of the chlorophyll-a seasonal means, 1991-2000 monitoring data were obtained from the CBMP data hub. Seasonal means were calculated simple as the mean of all surface layer chlorophyll-*a* values by segment and season (spring & summer). These seasonal mean values were compared to water quality criteria. Standard deviations were calculated for segment-seasons for which the seasonal mean values were below the criteria (Table A.1). This represents a simplification of the full CFD-based assessment process, but was conducted to identify the approximate standard deviations of seasonal mean chlorophyll-a values in segment-seasons that are likely to be in attainment.

**TABLE A.1—Standard Deviation of Seasonal Mean Chlorophyll-*a*, 1991-2000**

| Season | JMSMH | JMSOH | JMSPH | JMSTF1 | JMSTF2 |
|---|---|---|---|---|---|
| Spring | 2.8 | 4.5 | 2.4 | 4.1 | 2.1 |
| Summer | 2.3 | 3.7 | 1.9 | 4.2 | 3.9 |

The power analysis was conducted using the software of Lenth (2010). Result (Table A.2) indicate that the MSD in seasonal mean chlorophyll-*a* is 2-4 ug/L for most attainment segment-seasons.

**TABLE A.2—Minimum Significant Difference in Seasonal Mean Chlorophyll-*a***

| Season | JMSMH | JMSOH | JMSPH | JMSTF1 | JMSTF2 |
|---|---|---|---|---|---|
| Spring | 2.3 | 3.7 | 1.9 | 3.3 | 1.7 |
| Summer | 1.9 | 3.0 | 1.5 | 3.4 | 3.2 |

## ATTACHMENT C
## Relative Percent Difference of Chlorophyll-*a* Measurements

The relative percent difference (RPD) of chlorophyll-*a* lab splits were calculated from 1991-200 James River data obtained from the CBMP data hub. An RPD was calculated for each sampling event for which chlorophyll-*a* data were reported for both "S1/LS1" and "S1/LS2" sample types. RPD was calculated using the following equation:

$$RPD = \left|\frac{x_1 - x_2}{(x_1 + x_2)/2}\right| \times 100$$

A total of 595 data pairs were available for the calculation. The mean RPD was 35%, but this value was strongly affected by outliers. The median RPD was 16%. There was no obvious graphical trend in RPD with chlorophyll-*a* magnitude.

cfb

# Exhibit F
# From Appendix M, Table M3 with only post processing for James LOE at 1/2 Potomac

| | Scenario→ | '91 -'00 Base Scenario 36.8TN, 4.3TP, | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year → | '91-'93 | '92-'94 | '93-'95 | '94-'96 | '95-'97 | '96-'98 | '97-'99 | '98-'00 |
| Cbseg | State | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal |
| JMSTFL | VA | 0% | 0% | 6% | 6% | 19% | 11% | 30% | 16% |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 9% | 13% | 16% | 10% | 13% |
| JMSMH | VA | 30% | 5% | 0% | 7% | 13% | 13% | 8% | 2% |
| JMSPH | VA | 20% | 5% | 5% | 22% | 22% | 22% | 0% | 0% |
| Cbseg | State | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal |
| JMSTFL | VA | 35% | 36% | 20% | 14% | 2% | 17% | 22% | 33% |
| JMSTFU | VA | 22% | 22% | 17% | 2% | 16% | 28% | 28% | 17% |
| JMSOH | VA | 0% | 0% | 0% | 0% | 1% | 1% | 1% | 0% |
| JMSMH | VA | 0% | 0% | 0% | 0% | 4% | 4% | 26% | 20% |
| JMSPH | VA | 0% | 0% | 4% | 6% | 6% | 0% | 22% | 33% |

| | Scenario→ | Tributary Strategy 27.5TN, 3.3TP, | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year → | '91-'93 | '92-'94 | '93-'95 | '94-'96 | '95-'97 | '96-'98 | '97-'99 | '98-'00 |
| Cbseg | State | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal |
| JMSTFL | VA | 0% | 0% | 5% | 5% | 5% | 0% | 7% | 7% |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 7% | 7% | 7% | 0% | 6% |
| JMSMH | VA | 4% | 1% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Cbseg | State | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal |
| JMSTFL | VA | 0% | 0% | 0% | 0% | 7% | 20% | 20% | 10% |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSMH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 16% | 15% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 12% | 12% |

| | Scenario→ | 190/12.7 Loading Scenario 26.6TN, 2.7TP, | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year → | '91-'93 | '92-'94 | '93-'95 | '94-'96 | '95-'97 | '96-'98 | '97-'99 | '98-'00 |
| Cbseg | State | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal |
| JMSTFL | VA | 0% | 0% | 2% | 2% | 2% | 0% | 0% | 0% |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 4% | 4% | 4% | 0% | 5% |
| JMSMH | VA | 3% | 1% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Cbseg | State | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal |
| JMSTFL | VA | 0% | 0% | 0% | 0% | 5% | 15% | 15% | 8% |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSMH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 15% | 14% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 11% | 11% |

| | Scenario→ | James L.O.E 1/2 Potomac 23.5N 2.35P | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year → | '91-'93 | '92-'94 | '93-'95 | '94-'96 | '95-'97 | '96-'98 | '97-'99 | '98-'00 |
| Cbseg | State | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal |
| JMSTFL | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSMH | VA | 1% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Cbseg | State | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal |
| JMSTFL | VA | 0% | 0% | 0% | 0% | ~~2%~~ | ~~6%~~ | ~~6%~~ | ~~2%~~ |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSMH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 1% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | ~~9%~~ | ~~9%~~ |

# Exhibit G
## Adjusted Values Based on EPA June 2010 Presentation

| | Scenario→ | '91 -'00 Base Scenario 36.8TN, 4.3TP, | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year → | '91-'93 | '92-'94 | '93-'95 | '94-'96 | '95-'97 | '96-'98 | '97-'99 | '98-'00 |
| Cbseg | State | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal |
| JMSTFL | VA | 0% | 0% | 6% | 6% | 19% | 11% | 30% | 16% |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 9% | 13% | 16% | 10% | 13% |
| JMSMH | VA | 30% | 5% | 0% | 7% | 13% | 13% | 8% | 2% |
| JMSPH | VA | 20% | 5% | 5% | 22% | 22% | 22% | 0% | 0% |
| Cbseg | State | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal |
| JMSTFL | VA | 35% | 36% | 20% | 14% | 2% | 17% | 22% | 33% |
| JMSTFU | VA | 22% | 22% | 17% | 2% | 16% | 28% | 28% | 17% |
| JMSOH | VA | 0% | 0% | 0% | 0% | 1% | 1% | 1% | 0% |
| JMSMH | VA | 0% | 0% | 0% | 0% | 4% | 4% | 26% | 20% |
| JMSPH | VA | 0% | 0% | 4% | 6% | 6% | 0% | 22% | 33% |

| | Scenario→ | Tributary Strategy 27.5TN, 3.3TP, | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year → | '91-'93 | '92-'94 | '93-'95 | '94-'96 | '95-'97 | '96-'98 | '97-'99 | '98-'00 |
| Cbseg | State | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal |
| JMSTFL | VA | 0% | 0% | 5% | 5% | 5% | 0% | 7% | 7% |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 7% | 7% | 7% | 0% | 6% |
| JMSMH | VA | 4% | 1% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Cbseg | State | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal |
| JMSTFL | VA | 0% | 0% | 0% | 0% | ~~7%~~ | ~~20%~~ | ~~20%~~ | ~~10%~~ |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSMH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 5% | 4% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | ~~12%~~ | ~~12%~~ |

| | Scenario→ | 190/12.7 Loading Scenario 26.6TN, 2.7TP, | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year → | '91-'93 | '92-'94 | '93-'95 | '94-'96 | '95-'97 | '96-'98 | '97-'99 | '98-'00 |
| Cbseg | State | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal |
| JMSTFL | VA | 0% | 0% | 2% | 2% | 2% | 0% | 0% | 0% |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 4% | 4% | 4% | 0% | 5% |
| JMSMH | VA | 3% | 1% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Cbseg | State | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal |
| JMSTFL | VA | 0% | 0% | 0% | 0% | ~~5%~~ | ~~15%~~ | ~~15%~~ | ~~8%~~ |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSMH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 4% | 3% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | ~~11%~~ | ~~11%~~ |

| | Scenario→ | James L.O.E 1/2 Potomac 23.5N 2.35P | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year → | '91-'93 | '92-'94 | '93-'95 | '94-'96 | '95-'97 | '96-'98 | '97-'99 | '98-'00 |
| Cbseg | State | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal | CL Spring Seasonal |
| JMSTFL | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSMH | VA | 1% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Cbseg | State | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal | CL Summer Seasonal |
| JMSTFL | VA | 0% | 0% | 0% | 0% | ~~2%~~ | ~~6%~~ | ~~6%~~ | ~~2%~~ |
| JMSTFU | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSOH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| JMSMH | VA | 0% | 0% | 0% | 0% | 0% | 0% | 1% | 1% |
| JMSPH | VA | 0% | 0% | 0% | 0% | 0% | 0% | ~~9%~~ | ~~9%~~ |